APR 17 1933

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MACHINE DESIGN

Simon Stevinus

AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

IF YOU KNOCK THE "L"

OUT OF KELLY

● Call it "L" or call it "X"—it remains the unknown quantity in the maintenance of the equipment you design after it reaches its owners. » » » When you knock *it* out—you knock out most of the grief of the designing profession. » » » "It"—as you have probably guessed—is the uncertain element of random lubrication. » » » First, to be sure, you must design into your equipment the Alemite High Pressure Lubrication System it needs. Second, be *most* sure that you specify the particular Alemite Industrial Lubricants needed to service this system properly. » » » When you have done these two things, you have knocked the "L" out of Kelly—the "X" out of the unknown quantity. » » » Alemite High Pressure Lubrication Systems PLUS Alemite Industrial Lubricants *will guard your equipment against needless wear in the hands of heedless operators!* » » » Write today for the Alemite story of service from the designer's standpoint.

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PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

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Compiled for the assistance of engineers confronted with specific design problems

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BOOKS are as much a tool of the engineer as his slide rule. Reference works, technical treatises and more general volumes concerning the design profession should be included in every designer's library. Occasional reference or more prolonged study will reveal the answer to perplexing problems, re-establish half-remembered data or suggest new design opportunities. MACHINE DESIGN regularly publishes reviews of the new books in the design field to assist engineers in making their selection.

Calendar of Meetings and Expositions

April 13-14—American Management association. Job order production and mass production conferences to be held at Hotel Statler, Cleveland, will include discussions on set-up time as it is affected by product design and selection of machines and equipment. John R. Goetz, 20 Vesey street, New York, managing director.

April 24-28—Knitting Arts exposition. Display of textile machinery at Commercial Museum, Philadelphia. Information may be obtained from the management at Philadelphia.

April 26-28—American Welding society. Annual meeting at Hotel Governor Clinton, New York. M. M. Kelly 33 West Thirty-ninth street, New York, secretary.

May 2-5—Chamber of Commerce of the United States. Annual meeting at Washington. D. A. Skinner, 1615 H street, Washington, secretary.

May 4-6—Gear Manufacturer's association. Annual meeting at Penn-Lincoln hotel, Wilkinsburg, Pa. J. C. McQuiston, First National Bank Building, Wilkinsburg, Pa., secretary.

May 11-13—Electrochemical society. Spring meeting at Montreal, Que. Dr. Colin G. Fink, Columbia university, New York, secretary.

May 25-27—Refrigerating Machinery association. Semiannual meeting at Homestead hotel, Hot Springs, Va. Fred Nolde, 23 South Fifty-second street, Philadelphia, secretary.

May 29-30—International Association of Blue Print and Allied Industries. Annual meeting and exhibition of equipment at Hotel Statler, Buffalo, Glen Edwards, 431 South Dearborn street, Chicago, secretary.

June 12-15—National Association of Purchasing Agents. Exposition and annual meeting at Hotel Statler, Boston. G. A. Renard, 11 Park Place, New York, secretary.

June 12-16—American Oil Burner association. Annual meeting and exposition at Stevens hotel, Chicago. H. F. Tapp, 342 Madison avenue, New York, secretary.

June 12-16—Water Works Manufacturers association. Annual meeting and exhibition at Hotel Sherman, Chicago. J. A. Kienle, 250 Park avenue, New York, secretary.

June 14-16—American Institute of Chemical Engineers. Semiannual meeting at Medinah Athletic club, Chicago. F. L. LeMaistre, 808 Bellvue Court building, Philadelphia, secretary.

June 19-21—Scientific Apparatus Makers of America. Annual meeting at Marraine lodge, Highland Park, Ill. J. M. Roberts, 100 North LaSalle Street, Chicago, secretary.

June 19-23—Confectioner's National exposition. Annual meeting of National Confectioner's associaton of the United States at Hotel Sherman, Chicago. F. S. Records, 111 West Washington street, Chicago, secretary.

June 20-23—American Foundrymen's association. Annual meeting and exhibition at Stevens hotel, Chicago. C. E. Hoyt, 222 West Adams street, Chicago, secretary.

June 21-24—American Society of Agricultural Engineers. Annual meeting at Lafayette, Ind. Raymond Olney, St. Joseph, Mich., secretary.

June 25-30—Sixth Midwest Engineering and Power exposition. At the Coliseum, Chicago. Exposition headquarters at 308 West Washington street, Chicago.

June 26-28—Institute of Radio Engineers. Annual meeting at Hotel Sherman, Chicago. H. P. Westman, 33 West Thirty-ninth street, New York, secretary.

June 26-29—American Society of Mechanical Engineers. Semiannual meeting at Stevens hotel, Chicago. C. W. Rice, 29 West Thirty-ninth street, New York, secretary.

June 26-30—American Institute of Electrical Engineers. Semiannual meeting at Edgewater Beach hotel, Chicago. H. H. Henline, 33 West Thirty-ninth street, New York, secretary.

June 26-30—American Society for Testing Materials. Exposition and annual meeting at Stevens hotel, Chicago. C. L. Warwick, 1315 Spruce street, Philadelphia, secretary.

June 26-30—World's Fair. This week has been designated as Engineer's Week at the Fair which opens June 1. Twelve national engineering societies are meeting and a number of expositions are scheduled. Information on the fair may be obtained from the management at Burnham Park, Chicago.

June 27-30—Society of Industrial Engineers. Annual meeting at Stevens hotel, Chicago. George C. Dent, 205 West Wacker Drive, Chicago, secretary.

MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

April, 1933 Vol. 5—No. 4

Utilizing Air Pressure in Brewery Equipment

By J. Kantor

Chief Engineer, Liquid Carbonic Corp.

ANTICIPATING the recently culminated action of the President and Congress and noting the nation-wide agitation for legalized beer, manufacturers of brewery machinery have been giving their undivided attention during the past year to the design of more appropriate and up-to-date bottling machines. Prior to prohibition 75 per cent of the beer sold was draught and 25 per cent bottled, but many brewers believe that the reverse will be the case at the present time. If this surmise should prove correct, manufacturers expect to witness an unprecedented demand for bottling machinery. Before prohibition legislation the largest bottle filling machine, consisting of 40 filling valves, was capable of bottling on the average 120 pints per minute. Today, the largest beer filler with 50 valves built by Liquid Carbonic Corp., Chicago, Fig. 1, will bottle 160 pints per minute and 110 quarts.

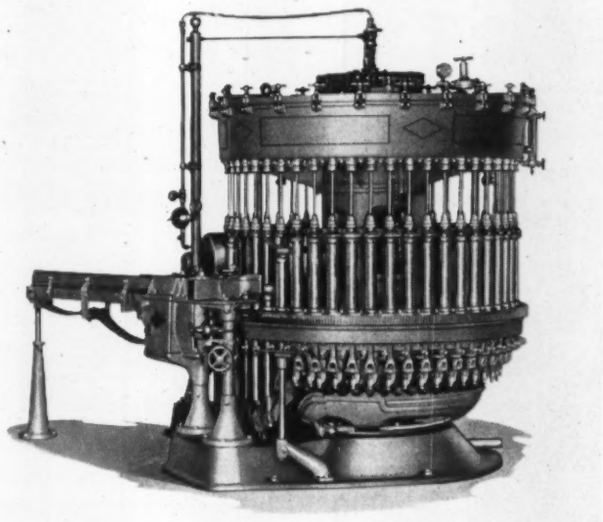


Fig. 1—Bottle filler has capacity of 160 pints per minute

The most perplexing problem faced in the design of beer bottling equipment is to provide efficient controls for filling the bottles quickly and yet eliminate excessive foaming of the beer while bottling. Foaming is an inherent property of the liquid and varies with the ingredients of the beer, its age, and with means and system of handling the beer at the filling machine. The principle of filling adopted for use is what is known as the counter-pressure principle. After a bottle engages a filling valve and is sealed, a counter-pressure valve opens, thereby connect-

ing the bottle with the air pressure that is maintained on top of the beer in the tank of the filling machine. Thus air pressure equal to the pressure on the beer in the filler tank is established in the bottle before the flow starts. Beer then runs into the bottle by an unbalanced gravity pressure of about one-quarter pound.

Flow Starts Gradually

A system of air chambers and water columns has been developed whereby beer is caused to start its flow into the bottle under this exceedingly low gravity pressure, hence very slowly and without agitation. As a consequence, no foaming takes place. When the filling tube valve, which is about 1¾ inches above the bottom of the bottle, is submerged, filling proceeds at a higher rate. Foaming does not take place when the valve is under the liquid.

Control of the speed of flow is obtained by regulating the air pressure which opens and closes a pear shaped valve, *A*, Fig. 3, thus changing the forces acting on a rubber diaphragm, *B*, which is connected to the valve by 1/16-inch phosphor bronze rod. The shape of the valve reduces agitation and permits a smooth discharge.

As the bottle is carried around the machine it is lifted into position by a cam mechanism to be described later. The bottle engages the bell top *C* and rises until it bears tightly against the bell top sealing mechanism. A sealing rubber on the bell top seals the bottle itself. In its uppermost position the bell top opens the counter-pressure air valve and permits the counter-pressure air (seldom more than ten pounds) to establish itself in the bottle and at the same time on top of the rubber diaphragm. As the air pressure on the bottom of the diaphragm is the same as that in the beer filler tank, it is less than the counter pressure. This unbalance depresses the diaphragm, opens valve *A* and permits flow.

Slow filling continues until the valve is submerged, during which time the bottle continues along its path around the machine. At the point in the travel when liquid covers the valve the bottle is connected automatically by means of the center air valve *P*, Fig. 2, to the lower pressure in the low pressure chamber *R*, Fig. 2 (discussed later). This creates a greater unbalance between the pressures above and below diaphragm *B*, Fig. 3, so the diaphragm is depressed further, the valve is opened wider and the beer flows faster. When the bottle is filled, and before it reaches the point in its travel where the cam mechanism lowers it, the center air valve shuts off the air communication to the top of the diaphragm, the air above the diaphragm is released to the atmosphere and the air pressure underneath raises the filling valve and shuts off the flow.

When a cracked bottle engages the filling valve, it will not open as the counter pressure of air will be lost from above the diaphragm and the unbalanced pressure necessary for opening the valve will not be created, hence no beer will be wasted.

The center air valve, Fig. 2, consists primarily of two parts—the water check tank cover *D* and the center air valve plate *F*. The check tank cover is connected by tubing to the annular beer tank and revolves with it, while the air valve plate is held stationary. In the check tank cover are drilled a plurality of equally spaced 3/16-inch holes corresponding in number to the filling valves on the machine. Two arcurate openings ¼-inch wide in plate *F*, one about twice the length of the other are connected

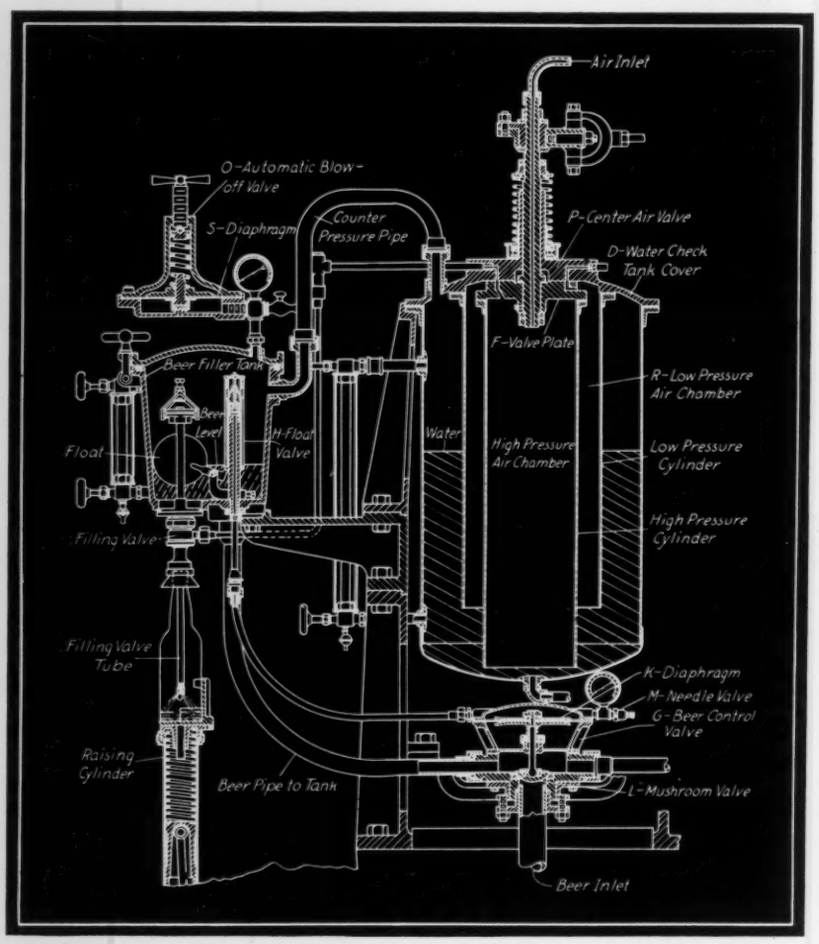


Fig. 2—Variation in air pressure controls flow of beer in such a manner that foaming is prevented

to the low pressure and the high pressure cylinders respectively. As the holes in the cover pass over the grooves, they are connected alternately first to the high pressure chamber and then to the low pressure chamber, thus connecting the bottle to be filled to these chambers, each filling valve being connected by annealed copper tubing to its corresponding hole in the tank cover.

An air operated control valve, *G*, Fig. 2, which functions in conjunction with a float operated air valve, *H*, on the inside of the tank was developed to maintain a constant beer level. When a certain level is reached, the float ball rises and opens valve *H*, thereby causing the air pressure above the beer in the tank to build up in the chamber above diaphragm *K* of control valve *G*. At a predetermined point this pressure depresses the diaphragm sufficiently to force the mushroom shaped valve *L* to seat and shut off the beer inlet.

As the beer is drawn off, the level in the tank recedes and the float ball drops, causing valve *H* to close and cut off communication with the tank. Excess air pressure in the control valve chamber escapes through needle valve *M* left open throughout the operation. Pressure of the incoming beer opens valve *L* and beer flows into the tank, repeating the cycle.

System Kept in Balance

In order to keep the filling system in balance at all times an automatic blow-off valve *O* was developed and mounted on the filler tank cover. This valve communicates with air pressure inside of the filler tank giving a pressure on the under side of it diaphragm *S* the same as that in the tank. A compression spring bearing on top of the diaphragm counterbalances this pressure. Compression of the spring can be regulated by an adjusting screw for any desirable pressure at which the system is to be maintained. If the air pressure in the tank exceeds that for which the spring is adjusted the diaphragm seat will be lifted and allow the excess air to blow off into the atmosphere. The seat remains open until the pressure beneath the diaphragm becomes equal to or slightly less than spring pressure.

The mechanism for raising and lowering the bottle to be filled consists of a drum cam, drop forged raising arms pivoting in a slotted revolving cone, and raising cylinders, Fig. 4. The raising cylinder assembly is composed of a capped brass cylinder housing, a spring and a crosshead to which it attached the connecting rod. A stop ring is provided for the crosshead on the inside of the cylinder near the bottom. The cylinder spring holds the bottle tightly against the filling valve bottle sealing rubber while the bottle is being filled.

The raising arm design was decided upon because the 12-inch lift required for a quart bottle (about 11½ inches high) can be obtained with a much smaller cam, both as to height and diameter, than would be possible if a direct cam lift design were used. Another objection to the direct cam lift is that the raising side of the cam would have to be exceptionally long due to the gradual, and hence long, incline necessary to overcome excess side thrust and binding on the raising cylinders. The lowering side also would have to be long and not too steep.

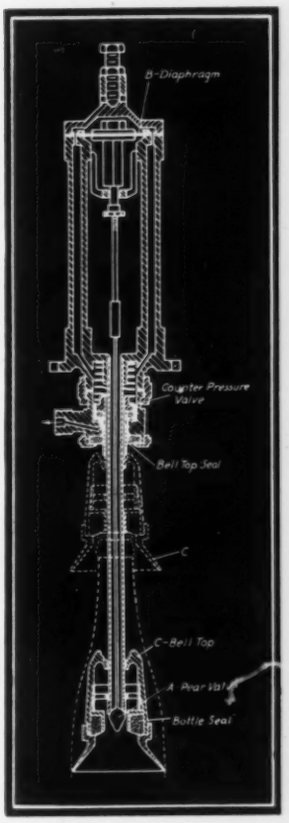


Fig. 3—Schematic view of valve used to regulate discharge. The bell top as it is raised by the bottle opens the counter-pressure air valve

If the direct cam lift had been employed, the high side of the cam would have been comparatively short due to the long incline and decline. This would mean that the capacity of the machine would have been reduced as the length of the high side determines the bottle filling time. Length of the raising and lowering sides of the indirect lift cam shown in Fig. 4, the type used on this machine, is about one-third as long as would be required for a direct lift cam. In addition, the longer bottle filling made possible by the adoption of the indirect lift principle increased the capacity of the machine 23 per cent.

Pressure Raised the Spider

On the experimental model of the first beer filling machine, it was noted that the spider of the machine, in which the raising cylinders are mounted, would lift about ¼-inch when the machine was running. This was due to the action brought about by the combined force of the compressed springs in the several raising cylinders acting through the raising arms and against the cam. The pressure of the cam rollers against the cam track resulted in a pronounced "drag" on the machine, and greatly increased the motor load. To overcome the lifting of the spider and to reduce the excessive motor load without decreasing the raising cylinder spring compression was, at first, a difficult and somewhat puzzling problem. It was, however, finally overcome by the development of a system of latches. These are swinging members, attached to the spider,

and they hold the raising arms high enough so that none of the cam rollers contact the high side of the cam.

The operation of the latches is as follows: Before hooking under the raising arm, they are held back out of the way of the arm as it is coming up on the raised side of the cam, by dragging over a stationary latching stand. Shortly after the raising arm reaches its highest position, rotation of the machine frees the latch from the latching stand and it swings downwardly under the raising arm, hooking under it and holding it

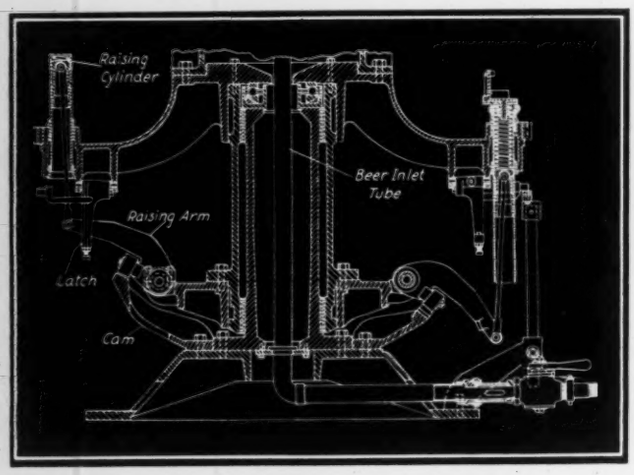


Fig. 4—A system of latches prevents combined force of compressed springs from lifting the spider

up. The cam is stepped down slightly from this point around to the disengaging position at the end of the dwell. To disengage the latch, as when the raising cylinder is to be lowered, the cam roller strikes the high point of the lowering cam strap thus slightly lifting the raising arm and cylinder and leaving the latch free. While the cylinder is thus held free of the latch, the latch drags on the stationary knockout stand which causes it to be swung backward out of the path of the downward moving arm. Thus by a comparatively simple latch system a difficult design problem was solved and operation of the machine was improved.

Bronze Ring Shrunk On

To eliminate a worm drive and gearing necessary to get a large reduction in speed, it was decided to cut gear teeth on the periphery of the spider. However, on a large iron casting such as this, it was deemed unwise to take a chance with brittle cast iron teeth. As an alternative, gear teeth were cut in a bronze ring shrunk on to the spider.

The bottle conveyor, feeding bottles into the filling machine, is driven by a spur gear meshing with this spider gear. In order to drive a horizontal shaft at right angles to the spur gear, a set of right angle bronze helical gears were used at first, the material being selected because of the moisture present. However, these gears were not successful as their life was decreased materially by ground glass from broken bottles working through and getting on the gear teeth. This trouble was overcome successfully by substituting cast iron gears for the bronze ones.

Clutch Design Difficult

On the first machine a clutch of the air-operated iron cone type was employed which required from five to eight pounds air pressure for its operation. It was noted that when bottles jammed and the safety gates opened, the machine would not stop instantly. The safety gates, in opening, depress an exhaust valve which exhausts the air from the clutch. With the higher air pressure required for operation of this clutch it was difficult to secure instantaneous stopping of the machine. To overcome this objection, a dry disk air-operated clutch was designed with the result that only 1½ pounds of air pressure are necessary. The lower air pressure permits the machine to be stopped immediately when a bottle jam occurs and the safety gates are opened.

Prior to the development of stainless steel, copper usually was employed in fabricating beer manufacturing equipment because it was economical and capable of withstanding any corrosive action of the beer. At present, however, stainless steel will replace copper in many instances.

Stainless Steel Employed

The important fact that stainless steel resists corrosion and that it does not discolor makes it especially desirable for brewing equipment. Cast brass also is used, however, for many of the parts on a beer filling machine because copper or stainless steel would be too expensive. Since brass is not quite as resistant as copper, all parts are silverplated and when thus protected they become practically immune to the action of beer. Tinning of brass parts is not practical as beer gradually attacks tin and, if in contact long enough, the liquid becomes cloudy.

As the filling machine is only one unit in a connected chain of machinery consisting of a bottle washer, capping machine, pasteurizer and a labeling machine, all of which operate on a continuous line of bottles, it was necessary to incorporate in the design a means of providing exact speed. To accomplish this, a variable speed transmission has been employed whereby minute changes in speed necessary for exact synchronization with other machines is obtained by turning a hand wheel. A silent chain drive transmits the power from the transmission to the rotating portions of the machine.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Corrugations Facilitate Expansion

CORRUGATED couplings used in expansion joints, solved a major problem encountered in the development of concentric tube transmission lines which now are finding extensive application in short wave radio transmission. In overcoming the mechanical difficulty due to expansion of the tubes, one of which surrounds the other, engineers of Bell Telephone Laboratories Inc., New York, have developed an interesting construction, Fig. 1. For electrical reasons such lines generally are made of copper or its alloys, these metals having temperature coefficients of expansion greater than those of ferrous metals. It was necessary therefore to provide some means of absorbing the change in length of the conductor as temperature changed.

Corrugations on the flanges, as shown in Fig. 1, were found to provide a better design than corrugations around the periphery of the coupling. When the latter construction is employed the corrugations must take up the entire change in the length of the line. With corrugations on the face of the flange their change corresponds only to that of the hypotenuse of a triangle, of which the base is the change in length of the line and the height the distance from the tube to the outer diameter of the coupling. The ratio of the change in length of the face to the expansion of the line is less than one-half the ratio of the change in length of the line to the height of the flange.

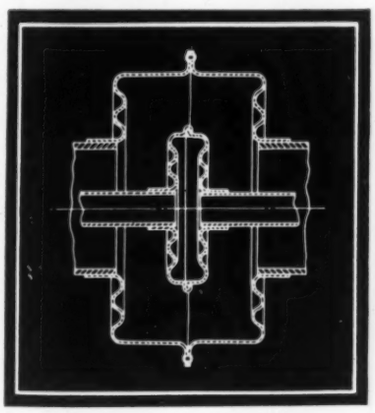


Fig. 1—Flanges with corrugated faces are employed in the design of an expansion joint which flexes like a diaphragm, accommodating a change in length of transmission tube according to temperature conditions

There are, of course, two of these corrugated couplings for each joint, one for each conductor. The design must allow for wide differences of expansion in the inner and outer tube.

Magnetism Solves Coupling Problem

UNDER high pressure conditions the practice of transmitting power by shafting through the chamber walls presents a problem in sealing to prevent leakage. The conventional pressure-tight bearing is of course a solution but its use sometimes may result in difficulties due to friction and binding, depending of course on the degree of pressure to which it is subjected. In a flow meter, designed recently by the C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., this type of bearing was discarded in favor of magnetic clutch. In other words magnetic lines of force are employed to couple the driving and driven members, thus eliminating the necessity for an opening in the walls of the pressure chamber. This same idea was used by a refrigerator manufacturing company in its earlier models to drive a fan on the outside of a sealed chamber. The motor was stationed on the inside and by magnetism which penetrated the walls, a coupling was established with the fan shaft.

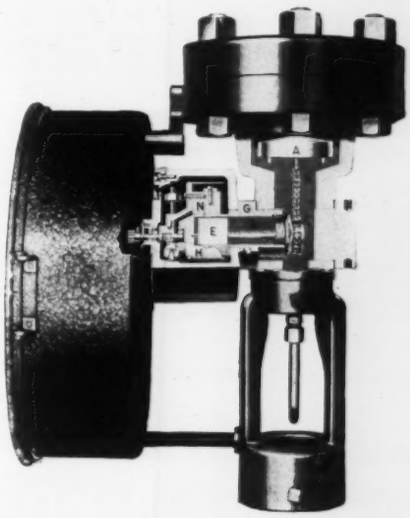


Fig. 2—Use of a magnetic lines of force permits elimination of a pressure-tight bearing in this flow meter. The magnetism acts as a coupling between two moving parts which are separated by a chamber wall

In the flow meter Fig. 2, a change in flow pro-

duces a change in differential pressure and a movement of the stainless steel float *A* which by means of ladder chain *B*, turns pulley *C* and shaft and rotor *E*. Rotor *E* turns in the closed end of cylinder *G* which is machined from non-magnetic stainless steel. Outside, the magnetic pole pieces *N* and *S*, Fig. 3, are locked to the rotor by magnetic lines of force, so that turning of the rotor turns the magnets outside in a fric-

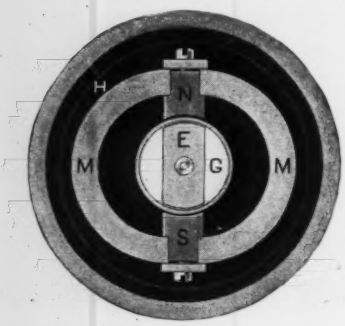


Fig. 3—Cross section through the magnetic clutching device showing position of rotor E and magnetic pole pieces N and S

tionless and positive manner. The external magnet assembly consists of two permanent cobalt magnets, the two north poles joining in pole piece *N* and the two south poles in pole piece *S*. This complete circular member is fastened to shaft *J* which is mounted on two sealed ball bearings. The end of shaft *J* projects into the instrument case where a pinion moves the pen arm across the chart.

Color Processes for Aluminum

DECORATIVE and protective coatings have kept pace with progress in design. As beauty in machines became as much a requirement as utility the matter of finishes assumed an important aspect. Among the coatings which provide both protection and color is Alumilite, developed by Aluminum Colors Inc., Indianapolis. The process by which it is produced is a chemical and electrochemical method of producing on an aluminum or aluminum alloy surface a uniformly hard abrasion-resisting and tenacious coating of aluminum oxide.

The coating, available in silvery white or in a variety of colors including black, blue, yellow, red, brown, green and purple, prevents smudging, staining, surface disintegration and abrasion. From the point of color effect alone the finish is unusually pleasing. The metallic background shows through the colored surface giving an effect like that of cloisonne. Alumilite properly applied offers remarkable resistance to salt spray and atmospheric and chemical corrosion.

"Coloral" is another process for coloring aluminum. It has been perfected and tested commercially by the United States Research Corp., Long Island City, New York. Designers will find interest in the fact that the new finish can be applied to die castings and sand castings as well as the aluminum sheets. Once applied to the original sheet, parts may be stamped from the sheet and formed without damage to the finish which may be in color combination or a single color.

The process consists of two stages; the first is the electrochemical oxidizing treatment which produces a hard non-corrodible, non-porous finish, and which also can be employed as a base for any other finish desired. The second state of treatment simply is an immersion in the coloring bath which penetrates the hardened oxidized surface and gives it a fast permanent color. If the objective is a protective coating only, the treatment terminates with the oxidizing step.

Independent Springing Gains Favor

INDEPENDENT springing for automobile wheels holds extraordinary possibilities in designing for riding comfort. The construction developed by Andre Dubonnet and Engineer Chedru is a recent effort in this direction; concurrently the mechanism may go even further afield as a basic idea for such devices as crane snubbers, etc. As explained in a recent issue

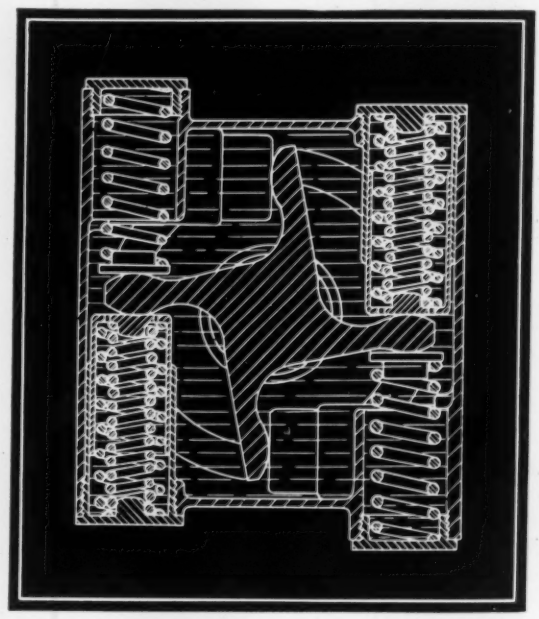


Fig. 4—Helical springs inside hydraulic pistons are employed in independent springing

of *Automotive Industries*, a series of short coil springs operating inside hydraulic pistons, Fig. 4, are employed. Each wheel has 12 sets of triplicate coil springs, nine for suspension and three for recoil.

Short arms on a ball bearing shaft contact the ends of the springs, the end of the shaft carrying an arm which holds the stub axle. A compact housing encloses the entire mechanism and is mounted directly on the chassis

frame. Pistons operate within cylinders screwed into the housing and adjustable holes permit escape of the oil. At the forward end the entire suspension is mounted on the steering pivot and turns with it; otherwise it is similar in design to the rear springing units.

Bellows Serves As Dust Protector

PROTECTION of sliding surfaces from dirt is one of the essentials in precision machinery. In grinding equipment particularly, where extreme accuracy is expected, means must be provided to keep the fine metal dust from interferring with operation and adjustment of moving parts. One method of accomplishing this is disclosed in the design of a profile grinder developed in Germany and marketed in this country by the George Scherr Co., New York.

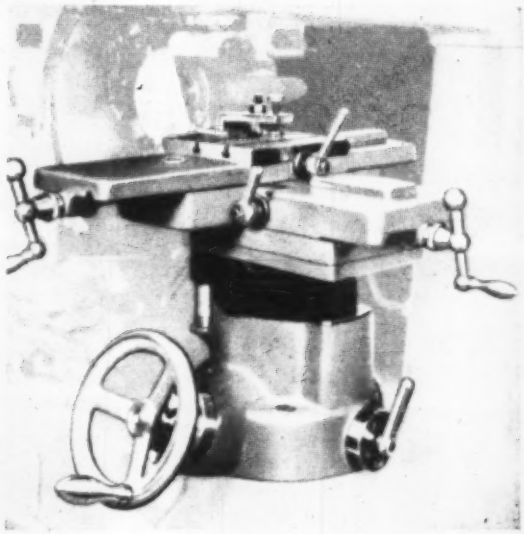


Fig. 5—A leather bellows, expanding as the table is raised, protects the column from dust

As shown in Fig. 5 the sliding surfaces of the table column are protected by a leather bellows. The folds of the bellows permit elongation as the column is raised through a hand wheel, bevel gears, screw and nut for sharply focusing the image in the microscope which comprises the optical attachment for checking the profiles. It is interesting to note that a metal bellows was employed to provide a seal for a moving switchrod in the water heater described on page 15 of the January issue.

Rail Wheels Cushioned by Rubber

RUBBER has become one of the engineer's major allies in combating shock, vibration, etc. Although bearing capacity of rubber is slight compared with that of metals, the designer can use it advantageously under extremely high loads. Proper design is the answer to the problem. In a new cushion wheel for rail coaches, for example, engineering principles new in application, introduce an idea that may have widespread influence in further demonstrating the versatility and possibilities of rubber where abnormal pressure is a factor.

Development engineers of the Clark Equipment Co., designers of the Autotram railcar (M. D., Jan.) and the B. F. Goodrich Co., have produced the cushion wheel, Fig. 6, which facilitates quiet operation of the car. Multiple soft rubber inserts, adjacent to the outer circumference are installed in a preloaded condition and carry the load, as well as traction and breaking effort, entirely in shear. These inserts are so disposed that all of the rubber in the wheel carries its full share of the load at all times. The rubber in the upper half of the wheel supports as much load as the rubber in the lower half.

Under shear loading of less than 10 pounds per square inch these cushion wheels easily support a load of 4200 pounds per wheel in the present installation and may be easily designed for loads up to 12,000 pounds or greater per wheel. Higher loads plus higher speeds present the greatest problem in a rubberized wheel. The new unit is designed for less than a 10 degree Fahr. rise in temperature at high speeds in a hot climate. As a related factor to heat generation, the radial deflection is maintained at a low figure. The less the distortion, the less the heat generated in the rubber. It is for this reason that the rubber inserts are preloaded by lateral compression as the wheel is assembled. By this means the soft flexing stage of rubber is removed with the result that on application of load or additional impact the rubber reacts instantaneously with its full load carrying capacity. The idea that has been carried out in the cushion wheel suggests a noteworthy consideration for other instances where rubber is employed under similar conditions.

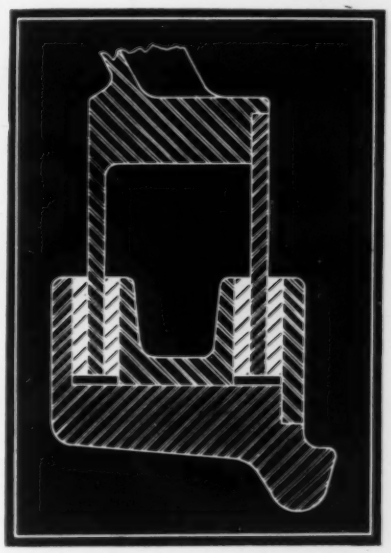


Fig. 6—Soft rubber inserts installed in a preloaded condition insulate the rail wheel rim from the wheel disk and axle to provide a cushioning effect. For noise and shock elimination the designers found a solution in rubber stiffened by compression in which condition the amount of heat generated per flexure is very low

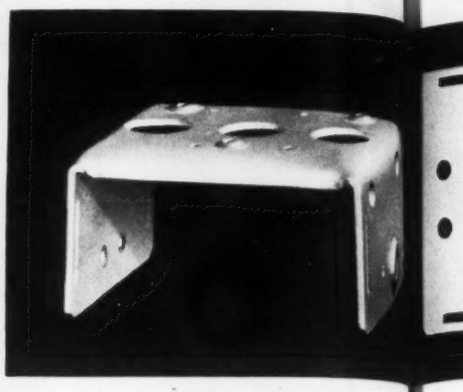


Fig. 1—Ductile coating permits forming operation on radio condenser blank after plating

Metallic Coatings

Combat Corrosion and Provide A

By Gustaf Soderberg

IRONS and steels offer an attractive combination of low cost and high strength, and therefore are used more than other metals. They have, however, two distinct drawbacks with which we are now concerned, a dead appearance and an innate tendency to rust.

One way of getting around these difficulties is found in alloying to make stainless steels. Another method is to apply a coating to the surface on the basis of "save the surface and you save all." The latter method is generally the cheapest and offers the greatest possibilities.

Rusting of steel is dependent upon the presence of both water and air on the surface. The first corrosion product formed is a green iron hydrate which quickly oxidizes to a brown hydrate. This substance loses water and becomes ordinary red rust. Both of these processes, the oxidation and the dehydration, are accompanied by volume changes which make the rust crack, and open up the road for continued attack.

To be of value from a rust protective standpoint electroplated coatings should envelop the material completely.

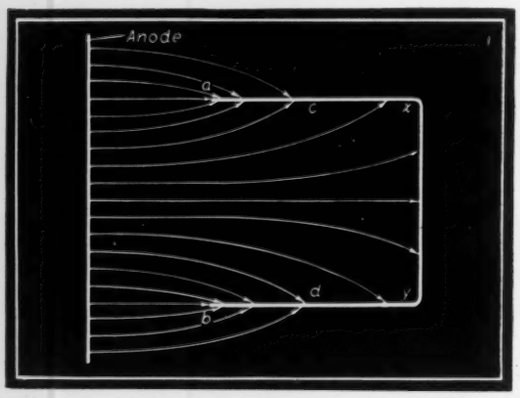


Fig. 2—Considerable amount of throwing power is required in plating deep recesses

Electroplated finishes can be grouped roughly into two classes. The first consists of several metals which are applied primarily for decorative purposes. Unless the coatings of these metals are nonporous, they will accelerate the rusting of the iron through the pores. Porosity is avoided by means of the application of heavy coatings. The second group is that class of metal finishes which are used primarily for the protection of ferrous metals against corrosion.

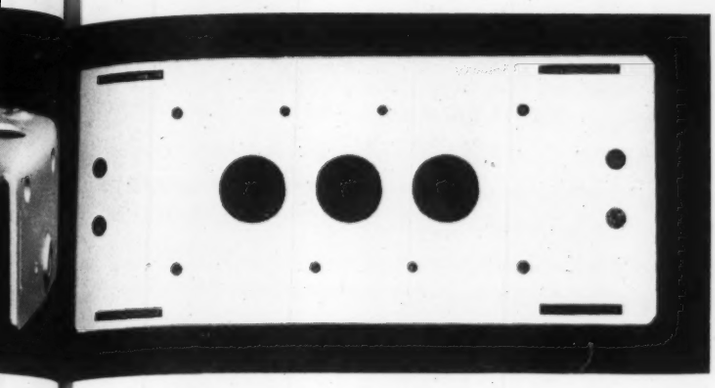
Decorative Coatings Discussed

In the first classification copper, nickel and chromium stand out as being most important. This group could be augmented by the addition of gold, silver, brass, rhodium and others, but these metals generally are not applied directly to steel with exception of brass. Cadmium is also decorative, but being at the same time a rust protective metal it will be treated later.

Wide use for copper plating is found in the production of decorative colored surfaces. By first coating with copper and then immersing in any one of a number of oxidizing solutions, a variety of attractive effects can be secured. It is necessary, however, that these oxidized surfaces be protected with a coating of clear lacquer which prevents air and moisture from reaching the surface.

Thin copper coatings sometimes are applied as a rust protective finish. This is bad practice as such coatings actually increase the rate of rusting of the steel.

Copper generally is used as an undercoating for nickel and nickel-chromium coatings. The main reason for this application is its cheap-



Plating in the flat permits production economies besides reducing number of parts held in stock

ide Attractive Finish

ness and softness which makes it comparatively easy to buff.

Nickel, when buffed, presents a pleasing surface with a slight yellowish tinge. When rust protection is desired, heavy coatings must be applied. The brilliant nickel surface has a tendency to tarnish which spoils the effect.

Chromium is a true finishing material, unsurpassed in its bluish brilliance and non-tarnishing properties. Wiping with a clean cloth restores a dirty chromium surface.

The ordinary chromium coating in use today is only about 0.00003-inch thick, and does not prevent rust. Rust protection can be obtained, however, by the use of heavy nonporous chromium coatings, though such coatings are too expensive for practical purposes. Chromium, therefore, is applied over thick coatings of nickel or copper and nickel, which furnish protection.

Zinc plate is the typically rust protective coating. No rusting takes place through pores in the coating as the zinc itself corrodes instead and protects the metal. Zinc is an extremely active metal chemically, and its sacrificial protection of the base metal often becomes rather severe on the coating itself.

Unfortunately, zinc coatings do not possess a pleasing appearance and turn dirty gray within a short time. Various methods have been suggested to secure the protective value of zinc and a more ornamental finish. The most satisfactory is the application of enamels, lacquers or japans over the zinc coatings.

Cadmium is a most interesting metal as it can be made to combine decorative value with efficient rust protection. Cadmium plate from "plain" solutions have a matte white appearance somewhat similar to zinc coatings. Coatings which are produced in baths compounded with proper addition agents are bright and lustrous. The luster of cadmium, while not indefinitely permanent, nevertheless endures for a long time. It is therefore to be compared with nickel in this respect. However, nickel surfaces must be buffed, as they come from the plating bath somewhat cloudy. This is not necessary with cadmium.

The main reason why cadmium coatings provide protection lies in the fact that they are resistant to atmospheric influences and are anodic to iron. Disregarding any electro-chemical discussion, this statement means that the cadmium has to be corroded away before the iron is attacked. Consequently, even though the coating may be damaged by mishandling, protection continues.

Cadmium Resists Alkalies

Cadmium resists alkalies much better than zinc which is dissolved readily by even weak alkalies. Strongly alkaline solutions attack cadmium, but weak solutions have little effect.

Coatings of this material are ductile and may be worked without peeling or chipping off. To illustrate this point, an actual case may be cited. In Fig. 1, two views of a cadmium-plated object are seen. The flat piece, a blank for a radio condenser shell, is plated in the form shown at the right. After plating it is stamped into the shape shown at the left.

Since the same blank is used for several different types of condensers, it would be necessary to stock approximately four times as many condenser frames as now are carried if the frames were formed before being requisitioned. To reduce the operations between specifications and application of the parts it is advisable to

PROPER design often makes it possible to obtain electrodeposited finishes, employed for protection against corrosion and for appearance, at low cost. In this article Mr. Soderberg, technical director, Udylite Process Co., Detroit, acquaints the designer with some of the possibilities of these versatile coatings.

plate them before forming, an operation which will not crack the ductile cadmium plate.

In the foregoing, mention has been made of "thickness of coating." In order that the designer may understand just what is meant by this term, specifications which govern cadmium coatings applied for the purpose of rust prevention will be outlined.

A coating less than one ten-thousandth thick has a number of microscopic pinholes through which the base metal is exposed. Corrosion is rapid in such cases. At a thickness of two ten-thousandths these pores are covered, with the result that a continuous film envelops the base metal. A two ten-thousandth plate is an efficient

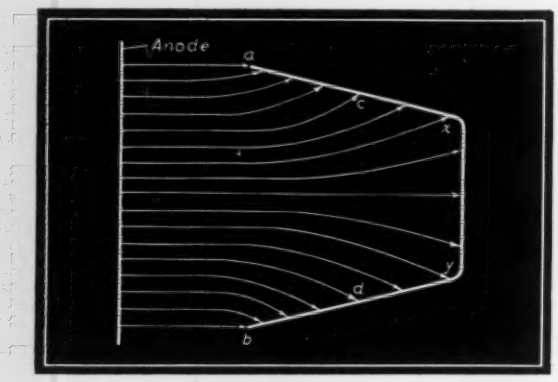


Fig. 3—Redesign of part shown in Fig. 2 widens the possible choice of plating solution

rust preventive where the degree of exposure is not severe, such as indoors.

When a four ten-thousandth plate is deposited the entire surface is covered with a continuous thick film and is amply protected against severe corrosion. In general, a two ten-thousandth coating is several times as rust resistant as a one ten-thousandth; four ten-thousandths more than doubles the efficiency of the two ten-thousandth coatings.

Specifications for thickness of cadmium therefore, should be two ten-thousandths for articles subject only to indoor corrosion and a minimum of four ten-thousandths for articles exposed to outdoor conditions. Where parts are plated to prevent rust while in stock or for a short period of time, a thickness of one ten-thousandth may be permitted.

Brightness, while important from the standpoint of appearance, also has a direct bearing on rust resistance of the plate. Tests have shown that a plate which comes from the plating bath bright lasts considerably longer than a dull plate of the same thickness due to the fact that a bright deposit is close grained. A dull plate is made up of larger crystals and is more porous. By retaining moisture and corrosive elements to a greater extent it is corroded more quickly.

Specifications as to luster are rather difficult to draw up since base metals differ so widely. About the only way of dealing with brightness is the simple requirement that the plate be lustrous and free from gray or burnt areas.

Uniformity of thickness is the major contribution to the efficiency of rust protective coatings. If a coating is two ten-thousandths thick at one point and one ten-thousandth at another, it is safe to suppose that the thinner portion will fail much more quickly than the thick one. It is of paramount importance that protective coatings be of sufficient thickness uniformly deposited on the surface of the article.

Some plating solutions have a greater tendency to deposit uniform coatings than others. Uniformity of coating thickness has a direct and intimate connection with that electroplating phenomenon known as "throwing power," this being the power of an electroplating solution to "throw" or deposit metal upon recessed surfaces.

Throwing Power Varies

Throwing power will vary from one metal to another depending on the native properties of the metal and on the type of plating solution used. Generally speaking, alkaline and cyanide baths have considerably greater throwing power than acid baths. The following commercial plating solutions are listed in order of their degree of throwing power.

Alkaline tin	Acid nickel
Cyanide cadmium	Acid copper
Cyanide copper	Acid zinc
Cyanide zinc	Acid chromium

Throwing power is of great importance for the reason that the design of an article frequently makes necessary the use of a solution with high throwing power and often is the deciding factor in choosing the proper electrodeposit.

Let us cite a typical example. Suppose a part having the cross section shown in Fig. 2 is to be plated and the actual choice of the electrodeposit has not been made. To make the conditions still more specific, suppose that point x and y must be coated with sufficient thicknesses of metal to provide efficient rust protection.

In the diagram, the arrows show the direction of the current coming from the anode. Fundamental laws tell us that the current which actually deposits metal on an object will take the shortest route.

Plating solutions which have poor throwing power will allow the current to become concentrated at points a and b with the result that thick metallic deposits form there. Points c and d will receive light coatings and points x and y only flashes or no coating whatsoever. The final result is a nonuniform electrodeposit exceedingly thick at some points and hardly anything on a surface where protection is desired.

The high throwing power plating bath per-

forms in an entirely different manner. In such solutions the points *a* and *b*, instead of drawing current excessively, resist the accumulation of recessed surfaces. Therefore, a high throwing power bath will produce a fairly uniform coating completely covering the inner surfaces.

Two courses are left open to the designer. He may either specify a metal which he knows can be applied uniformly or he can change the design of the object to place it within reach of poor throwing power baths.

Should the engineer choose to redesign his products so that its cross section approximates that shown in Fig. 3, his choice of electrodeposited metals is broadened. Even though the part is redesigned as suggested, the solution with higher throwing power will still provide a more uniform electrodeposit.

It was stated previously that a designer has two courses open to him, when confronted with the plating of an object as shown in Fig. 2. Another method of plating this part could have been cited, namely, the inside anode method. The use of inside anodes, however, is to be avoided except in those cases where all other methods fail. The method requires special set-ups and a great deal of handling and therefore is out of the question for production work where economy is to be considered.

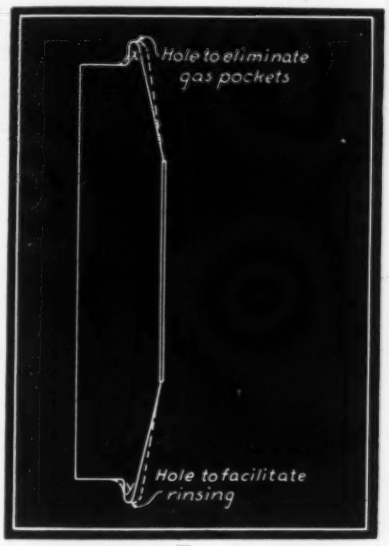


Fig. 4—Long narrow openings that may introduce difficulty in securing proper deposit present a problem that can be overcome by redesigning to open up the area

Elimination of sharp corners will help those in charge of the plating department. A sharp corner draws current and since it presents an extremely small area the proportion of current to surface area easily goes out of balance. It is much more simple to plate a rounded corner. When sharp corners cannot be avoided, for example, on threaded surfaces, it is most desirable to use coatings that can be applied in solutions with higher throwing power. Thus nuts and bolts are being plated with cadmium because it may be deposited uniformly in the bottom of the threads without undue building up on the high points. As the thickness of the deposit is small, there is no need for undercutting threads.

A typical plating problem involving the plating of an automobile hub cap, an approximate diagram of which is shown in Fig. 4, may be cited. It is desired to plate the interior of this object. From the standpoint of the plater, there are several difficult problems associated with the plating operations and it is important that these difficulties be understood by the designer as they might occur in the coating of many parts.

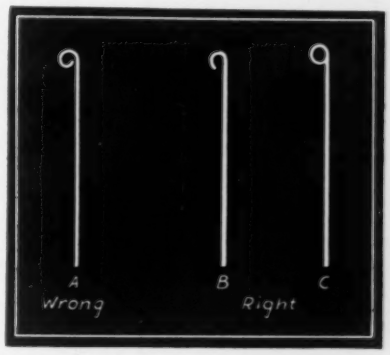


Fig. 5 — Partially closed beads on a part are difficult to plate and tend to prevent escape of gas and rinse. Redesigning to open these beads or closing them by soldering or welding benefits the part

Points *x* and *y* are walled in so completely between metal sides that it would be extremely difficult to plate these points. Even the best of plating solutions would have a difficult time with such a design and could not throw much metal at *x* and *y*. In the case where protection at these points is essential, redesign is practically demanded. The distance between the walls must be increased to permit coverage as shown.

Still another difficulty exists with the design of this part. How are parts such as these going to be rinsed easily and thoroughly? From a study of the sketch, it is seen that rinse water, plating solution and acid material will be trapped at *x* and *y* and carried over from one tank into the next. The manner of overcoming such tendencies successfully is to drill or punch a sufficiently large hole in the outer rim of the hub cap at the lower point to provide drainage.

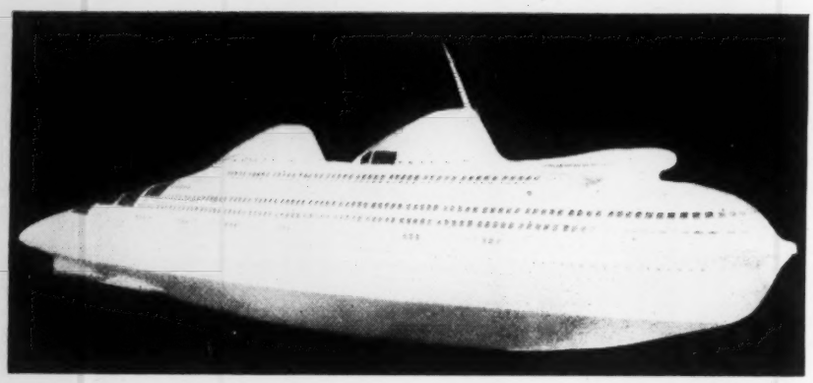
Gas Pockets Are Troublesome

Small holes in an object overcome another plating difficulty, namely, gas pockets. Practically all metal deposition is accompanied by creation of hydrogen gas which forms gas pockets. If the gas is not allowed to escape, it prevents the plating solution from coming in contact with the surface to be plated and no metal is deposited. A hole at point *x* in Fig. 4, would provide means for escape of the gas.

Beading of edges is an important consideration to the designer. In Fig. 5*A*, is shown a bead which always will cause trouble in plating. The opening is so small that little metal will be deposited on the inside. Still the atmosphere has ready access to the inner surface and will

(*Concluded on page* 58)

Horizons in Design



Review of Norman Bel Geddes' New Book "Horizons,"

By

Harold B. Veith

LOOKING ahead through the eyes of Norman Bel Geddes, famed artist and designer, reveals an amazing picture. Industrial design has come into its own with new types of equipment, factories, machines and homes with all their accoutrements fashioned to blend with the changing scene. From beginning to end of his new book, "Horizons," the reader's interest is held by the panorama of revolutionary ideas. One wonders sometimes if the nerves of the masses could weather such radical design changes if carried out in rapid succession. Would there be a reversion of feeling toward the old order?

Questions may arise regarding designer Geddes' grasp of the psychological side of this transformation and the mechanical practicability of his plans. To the first the answer is decidedly in the affirmative. He understands man's one outstanding failing, the limitations of his horizon, and does not attempt to force his ideas to immediate conclusions. As to the technical aspect of his designs the discussion reveals that he has not neglected to think things through. Unlike many artist-designers he does not stop with the mere shell, but first ascertains whether it has more than esthetic value.

Witness his thoughts on springing of automobile wheels, an engineering subject that even the automotive engineer does not seem to have considered as profoundly as the idea deserves. Springs of an entirely new design are necessary, he charges. When these are developed, each wheel will be sprung independently; new types of springs and power plants will make possible the use of a lighter frame which will be incorporated into the body structure.

Since the book was published late last year some of Geddes' predictions in design already have materialized. Others, as for instance the ship shown in the accompanying illustration, may be a considerable way off. The author realizes that public acceptance must be won by degrees. Then there are manufacturing costs, new tools, dies, etc., to be considered. In most cases the changes will come as a step by step process, of which the streamlined automobile is an outstanding example.

Good Design Requires Exhaustive Study

One of the secrets of Mr. Geddes' vivid picture of industrial needs is his close association with executives who have concrete problems before them. He disseminates words of wisdom which could be followed profitably by every designer. All possible information, he sets forth, must be gathered about every matter that can in any way influence design. Specifically these are recognized as the fundamental preliminaries to actual creation. Research and study of every phase, including methods and equipment for the production of the product, and even details of merchandising are stressed by Mr. Geddes.

The keynote of the volume rests with the assertion that progressive business means new ideas, and new ideas invariably stimulate progress in design; progress in design brings technical progress. There are parts of the book that the purely mechanical-minded man might find slightly irrelevant but for the most part it is deserving of more than casual reading.

"Horizons" is published by Little, Brown & Co., Boston, and is available through MACHINE DESIGN for $4.75 plus 20 cents postage.

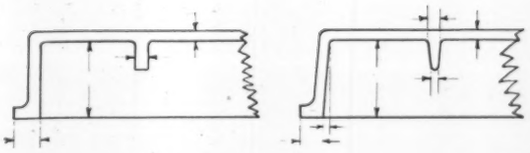


Fig. 1—Casting without (left) and with (right) proper taper for easy removal of pattern from the sand

Nonferrous Materials Affect Casting Design

Fig. 2—Irregular (left) versus regular (right) parting lines

ALL castings are designed with the thought in mind of answering a certain purpose or performing a given function and, in the selection of any particular alloy, these factors always should be uppermost in the designer's mind. In order, however, to attain the best results, factors which influence foundry practice and foundry technique must be given careful study. It should be remembered that certain general consideration apply equally well to the casting of all nonferrous alloys whereas other considerations apply more specifically to a particular alloy or group of alloys.

The committee on recommended practices, nonferrous division, of American Foundrymen's association, has compiled a list of fundamental suggestions relating to the design of nonferrous castings. An abstract of these recommendations is given in the following.

Co-operation. To avoid unnecessary expense submit tentative designs to the foundry for suggestions as to possible changes, which, while not affecting the utility, may aid in simplifying foundry practice and make a better or a cheaper casting, or both. Either the designer or the foundryman must visualize the molding methods applicable to the design and make such modifications as may be necessary to insure a good product.

Draft Must Be Considered

Draft. Regardless of type of pattern equipment, draft and shrinkage must be considered in all pattern designs. Sufficient taper on all vertical faces must be allowed to remove the pattern from the sand without excessive rapping and subsequent patching, Fig. 1. Drawings should specify whether this draft is to be added to or subtracted from the casting dimensions as given, because such draft frequently affects the subsequent use of the casting.

Shrinkage. Shrinkage is an important consideration in the production of castings and must be considered and allowed for not only by the patternmaker and foundryman but also by the design engineer. On average size brass castings, 3/16-inch per foot is the customary allowance, while on average size aluminum alloy castings it is 5/32-inch per foot. Total amount of shrinkage in any casting depends upon size and shape, its freedom to contract in the mold during cooling and the material used.

Avoid Irregular Parting Lines

Parting Lines. Parting lines should be made as even as possible to facilitate molding. Avoid irregular and multiple parting lines because they tend to molding complexities, dimensional irregularities and higher cleaning costs, Fig. 2.

Locating Points. Locating points to be used by the machine shop should be indicated on the drawing so that castings may be checked from the same point of origin by the pattern shop and foundry. They should be so placed as not to be influenced by a core shift. The points should be as far apart as the size of the casting permits in order to insure the most accurate results. Jig

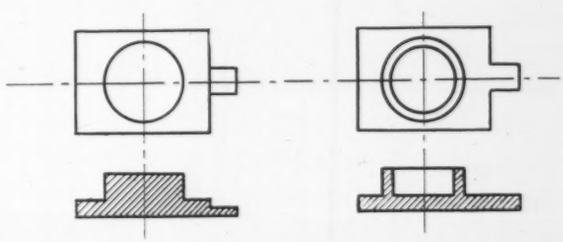


Fig. 3—Undesirable (left) and desirable (right) design of lug or boss from standpoint of metal section

spots are important items frequently neglected until the casting is made with much subsequent loss.

Dry-Sand Cores. It is desirable, wherever possible, to avoid dry-sand cores because of the higher cost. Where the cooling metal contracts around a dry-sand core, strains and cracks frequently develop because the core does not yield sufficiently to the cooling metal as it contracts. This is of particular importance on aluminum alloys and on many of the brasses. Cores should

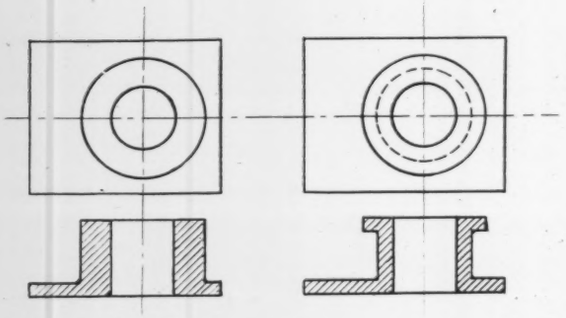


Fig. 4—Flange body of varying (left) and uniform (right) sections, both offering same bolting surface

be designed of sufficient thickness to be handled satisfactorily and set without excessive breakage. Sufficient thickness also is desirable to prevent the molten metal from burning through the core and increasing the cleaning cost.

Green-Sand Cores. Green-sand cores are preferable to dry sand wherever it is possible to use them, because of lower cost, cheaper cleaning expense, etc.

Finishing. The design of a casting often is a serious consideration in the cleaning and trimming cost, which may far outweigh the molding cost. It is well to keep in mind the expense in-

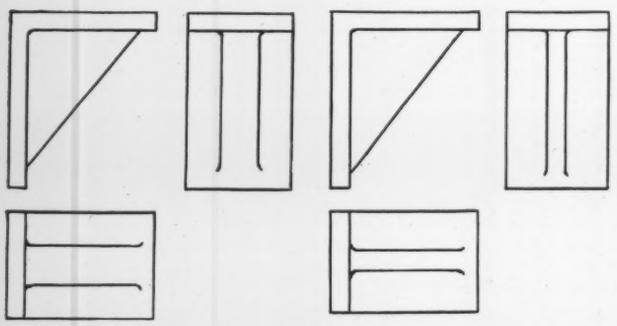


Fig. 5—Rib poorly designed (left), and rib of proper proportions (right) with correct taper

volved in cutting off risers in inaccessible spots on the high-shrinkage alloys such as manganese-bronze or iron-aluminum bronze, or on the alloys difficult to machine, such as gear bronze.

Section Uniformity. Uniformity of section thickness is especially desirable from a foundry standpoint, Figs. 3, 4 and 5. This equalizes rate of solidification, an essential consideration in the manufacture of quality castings, and simplifies both gating and feeding. Nonuniform solidification sets up internal strains and causes shrinkage defects and cracks.

Joining Sections. Where the design is such that light and heavy sections join, a gradual increase is desirable in the thickness of the thinner section toward the point of junction, Fig. 6.

Minimum Section Thickness. The nonferrous foundryman frequently is asked what minimum section thickness he can cast successfully. This, of course, varies materially with the alloy, size and intricacy of the casting, pressure requirements, etc. Castings poured at an excessive temperature to run thin sections generally are deficient in physical characteristics and should be avoided. On brass and bronze, 3/32-inch is considered the minimum satisfactory metal section. With aluminum alloys, 1/8-inch has been cast satisfactorily, although a minimum thickness of 3/16-inch is preferable.

Bosses Lead to Difficulties

Bosses and Lugs. Bosses and lugs are common in all castings and frequently lead to foundry difficulties. Where they join on to a thinner section of a casting, nonuniform solidification must be provided against. This may be accomplished by a riser acting as a feed for the boss, or a metal chill (generally cast iron) may be placed against the face of the boss. Such a chill simply tends to equalize the rate of solidification and make it more or less identical with the thin section of the casting. On larger nonferrous castings, bosses frequently are designed specially to maintain uniformity of metal sections and thereby simplify foundry practice and at the same time make a stronger job. The saving in material cost is an added consideration.

Bosses and lugs often are located on an interior portion of a casting, in which case the casting should be so designed as to provide heavy sections of metal leading to a feeding source; or some special provision should be made to provide for these heavy sections, as with chills, for example, Fig. 7.

Fillets. Generous fillets at all intersections will reduce foundry scrap materially due to shrinkage and cracks at these points. Sharp angles are apt to produce sand wash in a mold and are a source of weakness in the casting, Fig. 8.

Ribs. Ribs are used primarily as stiffeners and as reinforcing members in general. The rib sections should have a fair relation to the casting section, inasmuch as the pouring temperature is governed to a considerable degree by the thinnest section in the casting. Thin ribs also, because of rapid cooling, may set up casting strains and cracks.

Pockets. Deep pockets and small recesses that

complicate drawing the pattern from the sand or lifting the cope should be avoided.

Metal Inserts. Inserts, generally iron or steel, occasionally are cast into aluminum castings such as handwheels and into gear-bronze blanks, overhead trolley-line suspension castings, etc. Such inserts should be knurled or grooved to insure mechanical bond, and sufficient metal must be provided around such inserts to eliminate cracks during solidification.

Machine Finish Allowance. Machine finish allowance must be specified whenever castings are to be machined, due consideration being given to size of casting, alloy, and machine set-up. On small size and medium size castings $\frac{1}{8}$-inch is a customary allowance, with correspondingly larger allowance on larger castings. On split railway motor bearings the allowance is about 1/64-inch at the parting for a grinding operation, and 3/32-inch each on the outside diameter and inside diameter on a side for machining.

Molding Position of Machined Surfaces. Ma-

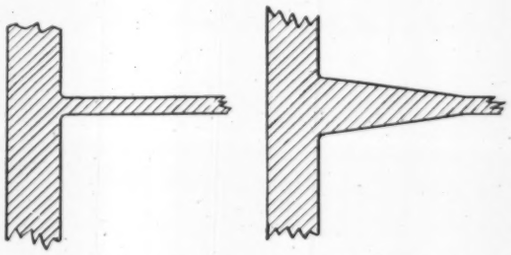


Fig. 6—Undesirable (left) and desirable (right) junction of light and heavy sections

chined surfaces, wherever possible, should be cast in the drag since then there is less chance of these surfaces containing defects such as shrinkage, dross and blowholes than with those surfaces in the cope. Where such finished surfaces must be cast in the cope, an extra finish allowance should be made.

Welding and Soldering. The welding and soldering of minor defects on nonferrous alloy castings is a recognized operation. It should be used with discretion, however, and only by experienced welders.

In the selection of an alloy for any particular application, the design engineer is influenced primarily by the physical characteristics such as strength, hardness, density, resistance to wear, weight, antifrictional properties, conductivity, corrosion resistance, shrinkage, melting point, color, polishing qualities, etc.

Often the demand is for a combination of a number of qualities in one and the same casting, and the designer then may find it necessary to compromise between the various characteristics that he wishes to incorporate in any one casting.

Aside from the physical characteristics desired, the design engineer is governed in his choice of alloy by the foundry technique available in the particular foundry doing the work, by the facilities of that particular foundry, and by the cost of the metal. All these factors markedly influence design and must receive careful consideration from the design engineer.

Pattern equipment for use in the production

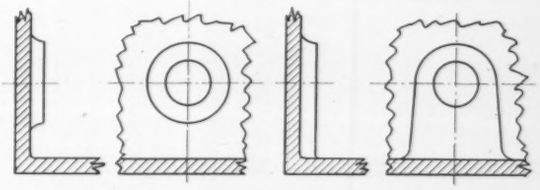


Fig. 7—Lug or boss at left requires loose piece, whereas lug at right extends to bottom flange, eliminating need for loose piece of pattern

of nonferrous alloy castings is not unlike that for iron or steel foundry use. The design and intricacy of castings, the activity and the production methods of the particular foundry doing the work determine the type of equipment best suited for the production of any particular casting.

Special pattern equipment, sweep patterns, skeleton patterns, etc., find only very special application in nonferrous casting work. The design engineer would do well to consider them only after consultation with the patternmaker and the foundryman.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN are:

"How Castings Meet Designer's Needs in Modern Machinery," by Dan M. Avey, Sept., 1929, p. 26.

"Whys and Wherefores of Gray Iron," by John W. Bolton, Oct., 1929, p. 22.

"Strength of Modern Aluminum Alloys Is Selection Factor," by F. V. Hartman, April, 1930, p. 22.

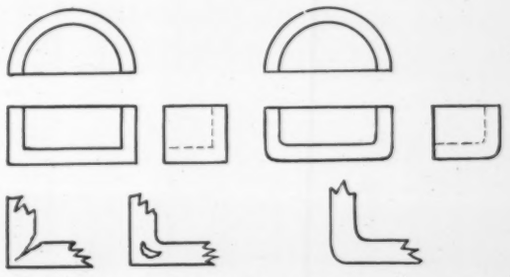


Fig. 8—Design at left has tendency to shrinkage cracks and cavities due to sharp angles and absence of fillets. Proper design right

"New Material Offers Many Possibilities to Designers," July, 1930, p. 40.

"Steel Castings as Machine Parts," by R. A. Bull, April, 1931, p. 36, and May, 1931, p. 37.

"Correlating Design and Foundry," by Alex Taub, Jan., 1932, p. 41.

"Combining Castings with Welded Structures," by J. G. Ritter, March, 1932, p. 40.

"Utilizing Tests in Casting Design," by F. C. Edwards, June, 1932, p. 36.

"Stamping Out Tradition in Casting Design," by F. A. Lorenz Jr., Aug., 1932, p. 33.

"Considering Design from the Production Standpoint, Part I —Founding," by Harold F. Shepherd, Dec., 1932, p. 15.

Motor Performance Is Proper Mounting

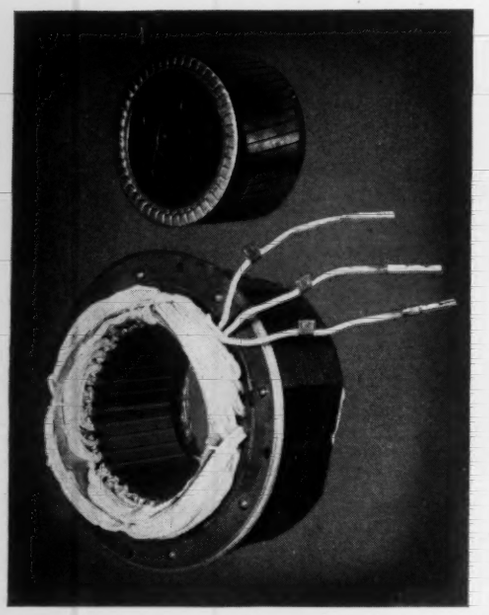


Fig. 1—Stator core and rotor may be incorporated in machine to simplify design

HANDICAPPING a motor by using an improper mounting is almost as detrimental to final machine performance as specifying an incorrect size of motor. Mr. Holston, Wagner Electric Corp., St. Louis, has outlined how mountings should be specified to obtain maximum motor performance.

HOW shall we mount the motor? This question is asked frequently by designers of motor driven machinery. There is now available to them a variety of commercially developed mechanical mountings which may be furnished by the motor manufacturer as an integral part of the motor or supplied as an adapter between the motor and the driven machine. The more commonly used types of mountings will be discussed in the following, as well as some that perhaps are not so well known.

The conventional horizontal mounting available in all types and sizes of motors is shown in Figs. 6, 7 and 8. It is the mounting most widely employed. For belt drives, sliding bases permit belt adjustment, this being accomplished by the use of separate subbases in the larger motors and by means of slotted motor bases in the fractional horsepower units. For direct connection, usually through a flexible coupling, the motor is bolted to a fixed base as no adjustment of the position of the motor is required.

Whenever its use is practicable, the standard horizontal motor mounting of the type shown in Fig. 6 is recommended in preference to any of the other types described in the following as this type is lowest in cost and is carried in stock in all standard ratings.

A universal mounting, Fig. 2, can be made up for standard motors where a single machine may require one of several sizes of motors. Hold-down bolts through the motor feet are fastened in slots permitting considerable latitude in endwise spacing, while the channels are moveable sideways on rods. This mounting, built into the machine, has been used on air compressors where the range of motor ratings is from ½ to 1½ horsepower. Motor frames vary, depending upon the horsepower, speed and whether twenty-five, fifty or sixty cycle current or direct current is to be used. Single and three phase motors may take different frames and of course motors of various makes are not always interchangeable. The rigidity of this type mounting is not sufficient for direct connection but works well with a belt drive, particularly when a V-belt is used.

The short-center flat belt drive is being used widely on motors from ½ to 25 horsepower. No idlers are needed and short-centers are possible. The motor is mounted on a pivoted base which is so arranged that the weight of the motor tends to produce a uniform belt tension regardless of whether

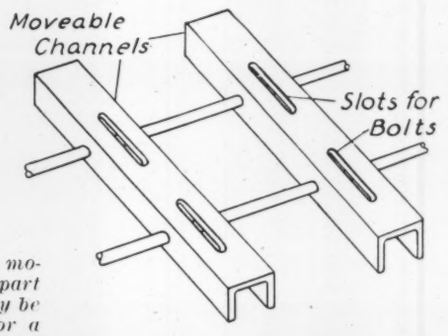


Fig. 2—Universal motor mountings as part of the machine may be used to provide for a range of motor sizes

ls Improved by

By James B. Holston

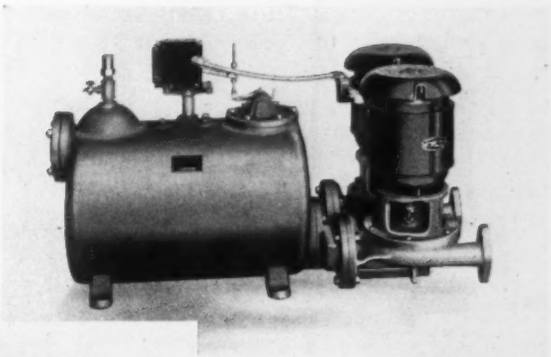


Fig. 3—(Right)—Barrel frame without feet permits the use of a clamp or band about the frame. Fig. 4—(Above, Right)—Adapters used with vertical motors simplify mounting

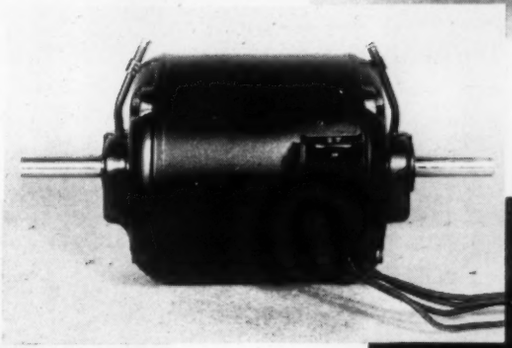


Fig. 5—(Below)—Horizontal motors incorporating special grease seals may be mounted with shaft vertical

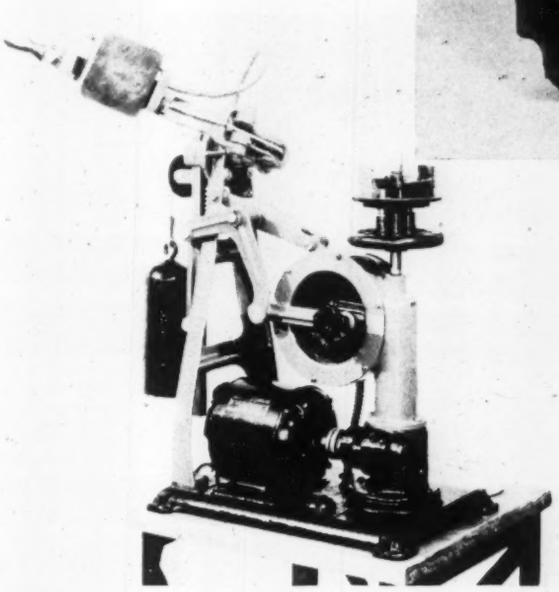
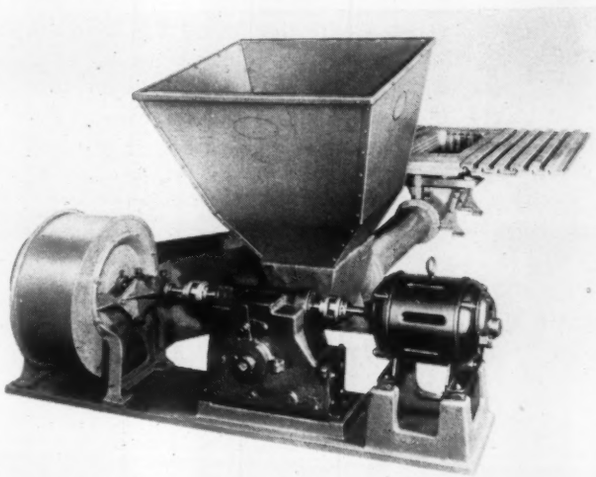


Fig. 6—(Above)—Horizontal direct connected motors are the simplest form of mounting. Fig. 7—(Below)—Where there is little likelihood of a change in motor size, permanent bases can be built up to support the motor



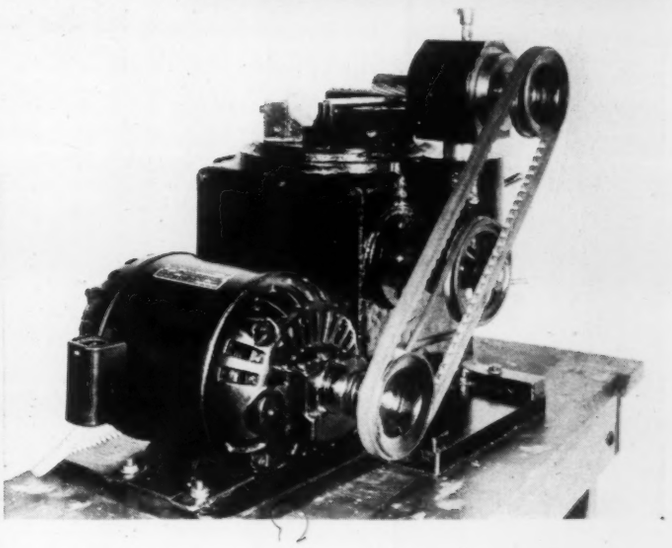


Fig. 8—Motors on standard horizontal mountings may be shifted to take up slack in belt or other driving means

the motor is at rest or running. When the motor is running and the belt elongates due to the forces set up, the motor moves, compensating for the increased belt length. In other words, by means of this pivoted base the proper tension is maintained automatically in the belt at all times by the motor weight and torque. Greater efficiency and longer belt life are claimed by the manufacturers of the base. In the application shown in Fig. 12, the spring base maintains proper belt tension.

Most vertical motors are used on pumps. A mounting adapter between motor and pump serves to simplify the mounting of the motor. Fig. 10 shows four types of adapters for vertical shaft motors while a typical installation is presented in Fig. 4. A tongue and groove fit between the motor and adapter assures correct alignment. A similar fit can be used between the adapter and the pump. The advantage of the adapter is that a range of motor sizes can be accommodated readily by making the required changes in the adapter rather than in the motor or pump casting.

Special Seals Required

Standard horizontal ball bearing motors, grease lubricated, may be mounted at any angle including a vertical position, Fig. 5. When ball bearing motors are mounted with the shaft in the vertical position special grease seals are required to retain the grease in the bearings. These motors will carry no extra thrust except the weight of the rotor and coupling.

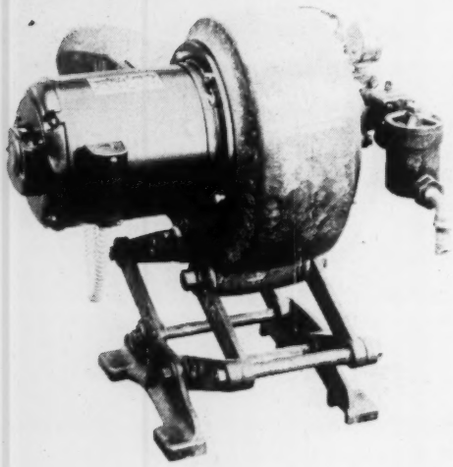


Fig. 9—Flanged mounted motors may be bolted to the machine as in the design of this oil burner, thus simplifying construction

Flange mountings are used on domestic oil burners, stokers and similar equipment usually driven by fractional horsepower motors. Fig. 9 illustrates one type of flange mounting. The motor shaft is horizontal and the end casting is machined to fit the mounting of the driven machine. This machined fit insures proper alignment and interchangeability.

If the motor is mounted with the shaft in any position other than horizontal, ball bearings should be used to take care of end thrust equal to the weight of the rotor.

Motors Designed Into Machine

Fans, blowers, unit heaters, oil burners and other similar types of machines occasionally require motors with no feet as shown in Fig. 3. These motors are designed into the machine. A band or clamping arrangement holds the motor in place. This method has its best application when used with fractional horsepower motors.

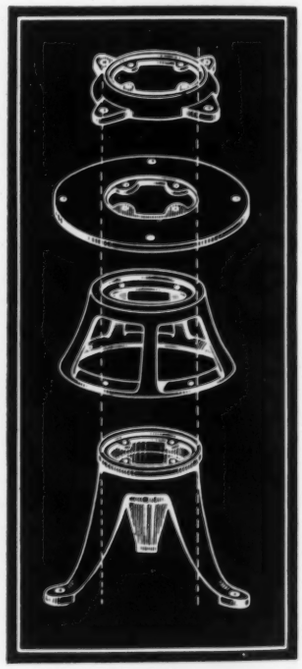


Fig. 10—Four types of adapters may be used to simplify the mounting of vertical shaft motors

Where quietness is necessary, a resilient mounting can be furnished which absorbs the vibrations of the motor. Quietness is a factor in domestic appliances which usually are driven by fractional horsepower single phase motors. Several types of resilient mountings are now available. Fig. 11 shows a resilient motor mounting together with a spring coupling which combine to eliminate transmission of motor vibration to the pump and thence through piping to other parts of the building where the machine is operating.

Spring Mountings Reduce Noise

A spring mounting between motor and base to obtain quiet operation is being employed in a number of applications where increased rigidity is required.

Various combinations of motor parts may be the most efficient expedient to suit the requirements of a particular job. A few such combinations which are available to the designer are listed in the following:

Wound stator with frame, with or without feet, rotor with shaft

Wound stator with frame, with or without feet, rotor without shaft

Wound stator without frame, rotor with shaft

Wound stator without frame, rotor without shaft. Fig. 1

Wound stator with frame, with or without feet, rotor without shaft, one end plate with sleeve or ball bearings

Wound stator with frame, with or without feet, rotor with standard shaft, with one end plate which may be sleeve or ball bearing

Certain special requirements may call for the

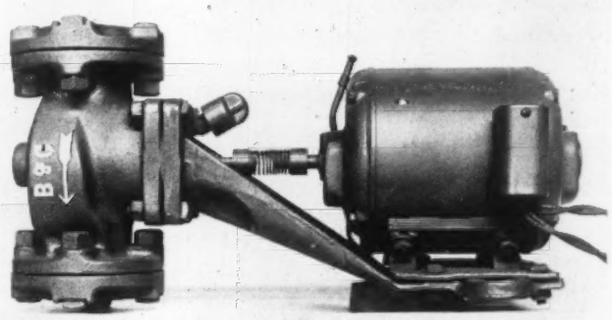


Fig. 11—Resilient mounting is used together with a spring coupling to secure quiet operation

motor design to be such that the motor is an integral part of the driven machine. In such cases complete motors may be furnished, or perhaps one of the combinations of parts listed in the foregoing.

Fig. 1 shows a stator core and rotor combination which was worked into a stoker design. The rotor is pressed on a shaft extension from the gearcase of the stoker and the stator mounted with a tongue and groove fit to the gearcase to insure the correct air gap. A sheet metal cover over the stator encloses the unit and makes a compact job. No lubrication is required as the shaft is merely an extension from within the gearcase, and the motor, therefore requires no bearings.

Combining Motor and Gears

Reduction gears may be built into the motor housing giving reduced shaft speeds. This type of unit was discussed in the January, 1933 MACHINE DESIGN.

Speed reductions also may be obtained efficiently by the use of a separate gear unit and a standard motor with a coupling.

From the description of various types of motor mountings it is apparent that a commercially developed motor design is available for almost every conceivable application. The developed motor frame nearest to that needed should be used rather than to require the motor manufacturer to develop a new design. This is perhaps of more importance to the ultimate

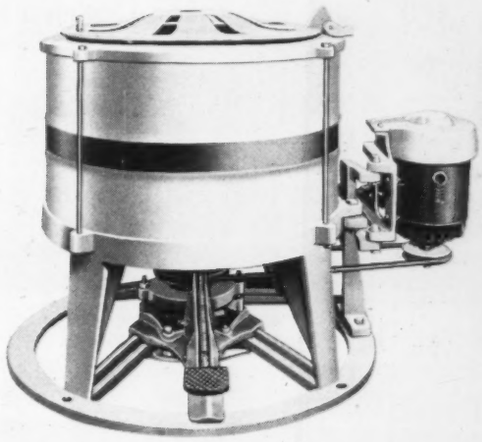


Fig. 12—Spring base maintains proper belt tension on horizontal motor mounted with shaft vertical

purchaser of the machine of which the motor is a part since replacement of a motor, if necessary, is made easier. The machinery manufacturer benefits in no small way, however, by using mechanical designs that have been seasoned by commercial use. His source of supply is more reliable, his first cost is reduced, his stock of motors of various ratings is decreased, and the problem of replacements and repairs is simplified. In addition, there is the satisfaction of using a design that has had the best test of all—commercial use.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN are:

"Do Linestart Motors Necessitate Changes in Design?" by E. W. Henderson, Dec., 1929, p. 38.

"Standardization of Motors," by J. L. Brown, Oct., 1930, p. 41.

"Special Motor Requirements Tax the Designer's Ingenuity," Nov., 1930, p. 36.

"Single Versus Multiple Motor Drives," by P. W. Arnold, Jan., 1931, p. 41.

"Twin-Motor Drive Yields Notable Advantages," by R. H. Wright and H. E. Stokes, July, 1931, p. 46.

"Motor Development Keeps Pace With Industry's Needs," by H. N. Blackmon, Jan., 1932, p. 35.

"Universal Motors Demonstrate Adaptability for Fluctuating Load Service," by E. L. Connell, April, 1932, p. 30.

"Compact Drive Units Improve Appearance, Cut Costs," by Allen F. Clark, Jan., 1933, p. 27.

"Selecting Motors for Specialized Requirements," by R. J. Owen, March, 1933, p. 18.

"Industrial research might seem at first glance to be a luxury item for industry to contemplate in these times of greatly curtailed resources, but in the long view there can be no question of the value of new energies which are continually being generated by research." Dr. Julius Klein as quoted in the *Industrial Bulletin* of Arthur D. Little Inc., for March, 1933.

Survey Shows Design Activity

Recent Investigation Indicates that Rate of Development of Machines Is Twice that of Production

WHAT is the future outlook for the engineering profession? In the minds of hundreds of design, development and research engineers who have felt the sting of present day conditions, this question is uppermost. The facts concerning the depression need no reiteration. There is however another side of the picture that presents a brighter aspect. In the face of curtailed production, depleted sales, bank moratoriums and a general business debility most companies have kept up their morale as revealed in a recent survey made by the Cleveland Engineering society. Of 76 plants in the Cleveland district, which locality may be taken as representative of machinery centers of the country, engineering department employment in two companies is 150 per cent of that in 1929. Seventeen plants have maintained the size of their engineering departments, employing the same number of men as in 1929. Supplementary data will be found in the accompanying table.

Most surprising perhaps is the fact that the total number of machines being manufactured still is 25 per cent of the peak year of 1929. The number of engineers now employed in the design of new machines or in redesigning old ones is approximately 50 per cent. Since this survey was made at the low point of the depression it is significant that so many engineers responsible for design of machinery continue in employment. If at such crucial times as these they remain in key positions there is no question but that the approaching months will find more employed.

Indicative of the increase in employment that can be anticipated are some facts relating to the brewery industry. Legalization of beer immediately afforded new avenues for the creation of machines, typical of which is the beer bottle filling machine described elsewhere in this issue. In a recent interview August A. Busch, president, Anheuser-Busch Inc., St. Louis, declared that his company will need $5,000,000 worth of new equipment. One of the large refrigerating machinery manufacturing companies reports that it already has quoted on brewery refrigerating equipment totaling $1,155,000 and during the first three days after the introduction of the beer bill received orders for well over $100,000 in machines. And so on through the various brewery centers.

It is somewhat early to expect a general wave of buying. The potential market gathers increasing proportions and when the "new deal" begins to show its effects the demands on designers will be still greater. The Cleveland survey is encouraging and serves to confirm the opinion that the engineer is one of the most indispensable factors in bringing the country out of the depression. The importance of vision and initiative in design is being more and more deeply impressed and when consumption comes into full play again the engineer will be in an excellent position to profit by the experiences of the past three years. The survey illustrates the feeling of the need for creative design work—the foundation on which industry is built.

Activity of all Companies Grouped by Rating

Company Ratings in Dollars	Percentage of 1929 Machines being mfg'd.	Percentage of 1929 Employment in Eng. Depts.
1,000,000 and over	26.22	54.09
500,000 to 1,000,000	20.46	49.85
300,000 to 500,000	25.13	77.66
100,000 to 300,000	21.25	26.50
50,000 to 100,000	25.00	24.89
Less than 50,000	25.57	23.29
AVERAGE	24.40	48.76

Activity Grouped by Percentage

Manufacturing (Companies Reporting)	Percent of 1929 Activity	Eng. Dept. Employment (Companies Reporting)
	150	2
1	100	17
1	80-89	1
3	70-79	3
1	60-69	2
5	50-59	13
4	40-49	....
7	30-39	10
17	20-29	10
25	10-19	6
12	*0- 9	12
76		76

*In cases where figures were not given, these were assumed to be zero and have been included as such.

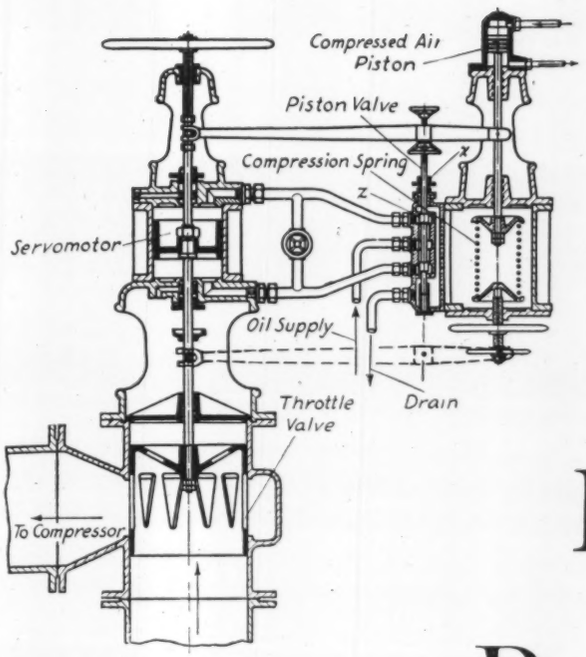


Fig. 1—Correct mathematical solution may not always give most practical design

Part V—Cylindrical Work

Considering Design from the Production Standpoint

By Harold F. Shepherd

MATERIAL is under stress in the process of tooling and deflections due to this stress may greatly limit production. In cylindrical work the job is often weaker than the tool, the converse of the usual condition in hole production (M. D., March).

Fig. 1 is an example of a regulating device much as it might be submitted by a designing engineer who is perhaps a shark at figures and something of an inventor. It may be assumed that the design is schematically practical.

It must be admitted that the parts of this apparatus may be made on engine lathes by skilled men. But six united cylindrical surfaces are required to slide freely in as many bores all on the same axis. Production, inspection and assembly are difficult. The main valve spindle is detailed in Fig. 2*A*. It evidently is four to six feet long and 1 to 1½ inches in diameter over most of its length.

Obviously, means should be found to make this job shorter since its transverse and torsional strength are totally inadequate to resist normal cuts in machining. Also the number of coacting guiding surfaces should be reduced considerably.

The chief engineer's instructions might be, "Lower the floating lever to new position as dotted in Fig. 1 and invert both valves, the air cylinder and spring assembly. The stem for the hand regulating wheel must be severed from the main valve spindle eliminating two sliding fits. To reduce the number of guides further, the main valve should be made reasonably if not perfectly free axially by simple means and the servomotor piston should be fitted with leathers, the detail *A* being altered to *B* and *C* Fig. 2."

Since strict axial alignment of the ends with the body of the spindle in *B* is now not essential, no specification need be given the shop as to the means to be employed other than "turn," "grind" and "thread." However, since it is guided at two points only, this final spindle design may be made of turned and ground shafting which always should be considered for long jobs. In that

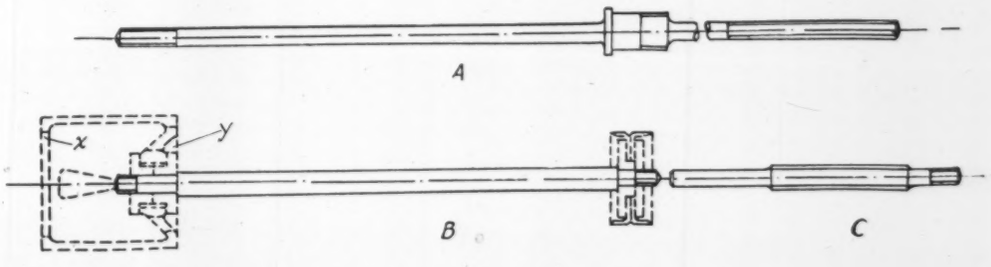


Fig. 2—Reduction in number of coacting guiding surfaces can be obtained by redesigning certain portions of Fig. 1

case the ends only require machining.

The detail shown in Fig. 2*C* is under moderate stress in use. It should be dimensioned for transverse stiffness in thread milling since that is the economical and precision means of cutting coarse square or acme threads. Follow rests are available for long threads but their use is not desirable from any viewpoint if it can be avoided. Dies stress the job only in torsion to all outward appearances, but axial threads are not assured by die cutting.

Other considerations influence design of short stiff jobs. Study of the limitations of both turret lathes and their nearest of kin the automatics should be urged upon the engineering staff.

The detail Fig. 3 is suggested as the stuffing box gland from the spindle. It is driven into

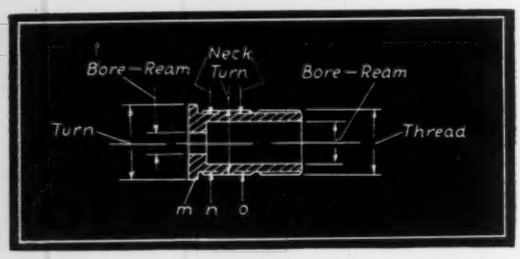


Fig. 3—Stuffing box gland is driven into bores rather than screwed in for greater accuracy

bores rather than screwed in for greater accuracy. Pressure will tend to retain it in place. The drawing calls for ten operations on this piece. If it were not for this fact it would be an ideal turret lathe job in brass or bronze.

Fig. 3 requires too many operations for the simpler turret machines. A little study reveals that surface *m* does not require turning. The necks *n* and *o*, although elegant, may be omitted. The holes may be bored only, better so in fact than bored and reamed. If these changes are not made operations may be omitted inadvertently by the shop or they may be carried out by two chuckings with serious loss of concentricity.

Further Suggestions Presented

This same general objective may be accomplished in seated and journaled spindles by making steps vary by a few thousands rather than by larger fractions and developing them on the grinder from a straight lathe roughing cut without necking for wheel run out. Also by avoiding or by milling the threads which may require three operations for chasing, necking and chamfering. Necking may be avoided by counterboring nuts or tapped holes, Fig. 5.

Short pieces are hard to hold or drive at times and if hardened when they reach the grinder there may be no way of machining them properly.

Soft work may be so designed that it can be finished from the bar at a single chucking. Also a porter piece may be provided on a forging for this purpose.

Work may be ground without centers if finish is the objective, but it is not advisable to finish high speed shafts carrying rotating members subjected to whip and critical speeds by this method, as camber or bow and wind cannot be eliminated. Center grinding should be specified when important.

The centerless grinder however, in which the work is sized by passing through the gap between two wheels, is a machine which has won the engineering world by reason of its high production. Study of its properties and attention to detail by experts in its design and operation have made it possible to produce on this machine work that is notable for its accuracy since basically it lacks the geometric properties of processing using centers.

Should Avoid Keyseats

For the numerous short hardened pins used in linkages the process is invaluable. While shouldered jobs can be ground by this method the detail designers attention should be devoted to using straight pins to accommodate his work more readily to the centerless grinder. Naturally, keyseats should be avoided in hardened centerless work. If centerless grinding is used on one step of a job only it is wise to specify that this be the key or locating operation to be caught in the collet when the dependent operations are executed.

The valve Fig. 2*B*, almost as difficult to turn as the proverbial tin bucket, requires a bored flange for stiffening and to guide a centering jig for use in grinding as shown at *x*. The boss *y* should be of such size that it may be faced on the chuck side by a tool inserted through the bore. The holes in the head are convenient chucking means, a necessity which always should be studied in design.

Valves like Fig. 1 *z* and their stems usually are lapped. Lapped stems in lapped bushings require no packing against high oil pressures. The requirement "lap" often is misun-

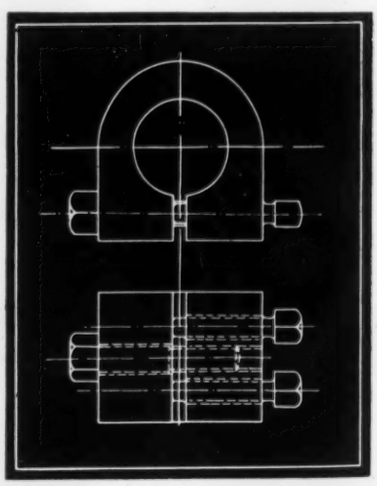


Fig. 4—Any adjustment required in laps, of cast iron or iron lined with lead, is locked rigidly by opposed bolts

derstood. That nut-cracker apparatus having jaws lined with emery cloth which is used to polish turned work is not a lap. Laps are of cast iron or iron lined with lead. They are expansible by screws and any adjustment is locked rigidly by opposed bolts, Fig. 4.

A few passes of a lap will show the quality of a surface remarkably well. Although these indications need not condemn the machine product for most purposes, they do show conclusively that lapping is advisable for journals which run under heavy loads or at some heat, both of which conditions thin the oil film so much that surface imperfections may be of such magnitude as to penetrate it.

Machine lapped parts are necessarily simple cylinders preferably with no diameters exceeding the lapped one. They are rotated between cast iron disks charged with oil and abrasive. Due to their nonradial position maintained in the machine by a spider held eccentrically to the center of disk motion, they rotate and reciprocate relatively to the disks in such a way as to produce the desirable mat surface.

The valve Fig. 1 *x* would be corrected to Fig.

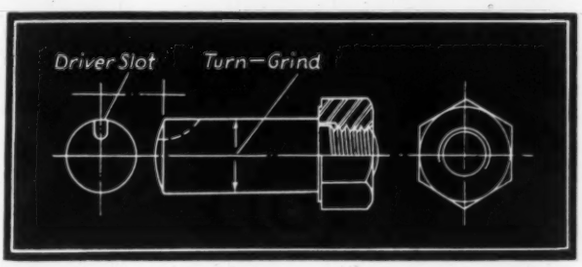


Fig. 5—Necking may be avoided by counterboring nuts or tapped holes

6 for either hand or machine lapping. For hand work the lap, of course, must be much larger than the slots. For machine work the job should be several diameters long but of no great length. Long jobs bow and consequently leak more than short ones under the same pressure since diametral allowances must be larger for assembly.

The mat surface is not always appreciated by buyers of lapped work so as a concession to appearance a few slow passes of hand laps may be permitted to produce parallel surface marks. Lapping machines working on the centerless grinder principle are on trial in commercial use and soon may be available to every works.

Honing also is in use for finishing cylindrical surfaces. The process is much like bore honing described in the March issue.

Formed jobs (knobs, handles, etc.,) are used perhaps more on machine products than on machines. The tendency of machine designers has been to eliminate profiles of nondescript geometry in favor of straight cuts. However, formed work must be made as a concession to popular taste.

Such profiles if required of lathes or automatics should be so designed that the formed operation is carried out as close to the chuck as possible and with the least possible linear length of cutting edge. This work usually must be done by the cross slide. In charting the operations on the part it may appear that by reason of limited tooling of this device some other mode of manufacture should be sought. Suggestions are drop forging and grinding of the profile from the rough and cold pressing.

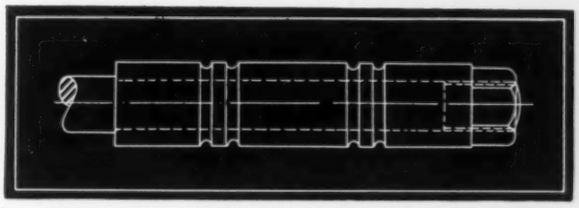


Fig. 6—For hand work the lap on this valve must be much larger than the slots

Many such operations are being carried out with formed grinding wheels on centers and on the centerless machine. In either case the designed profile should hinge on the means of truing the wheel. Special fixtures for the purpose of dressing wheels to odd profiles are made by the grinding machine builders. The mechanism of these devices may be much simplified by collaboration between the designers of the product and the tools perhaps without any loss of grace in the product.

Avoid Long Threaded Parts

Long threaded fits are to be avoided in design. A well fitted thread in steel of a length equal to half a diameter is equal in shear to the tensile strength of the bolt. If the length of thread fit does not exceed one diameter as in standard nuts and if the fit is of the running or free class, die cut threads made on machines in which the work drags die and carriage may be satisfactory. When the threads must drive interchangeably into tapped holes and particularly when the length of fit exceeds one diameter for wearing purposes, a lead screw machine or its equivalent should be employed.

For long work as piston rods, tie bolts and even studs, threading operations should be conducted on centers. There is little use of using alloy studs if it becomes necessary to bend them cold at the thread root after driving to plumb them with the holding surface. A design alternative is to design self-aligning fastenings.

The several diametral tolerances should be required on all drawings for roughing, grinding, and if required, lapping. Some of the allowances particularly for hardened work and for long work may have to be developed in the shop although the grinder manufacturers issue tables covering usual cases. Allowances and tolerances for lapping especially should be agreed upon after due trial and recorded.

Editorial

Machine Builders Recognize Desirability of Maintaining Design Staffs

ELSEWHERE in this issue, MACHINE DESIGN presents a brief summary of an investigation by the Cleveland Engineering Society of the production and design activities of 76 machinery manufacturers. The findings may be assumed to be quite representative because they are based on returns from companies of wide diversity in size and in the character of machines manufactured.

The significant point brought to light by this study is that while the number of machines being manufactured early in 1933 was at an annual rate of 24.4 per cent of the number manufactured in 1929, the number of employes in engineering departments engaged in the design and redesign of machines early in 1933 was 48.8 per cent of the 1929 total.

Manufacturers of household and office machinery fared somewhat better than builders of industrial machinery. In the first named group production was 33 per cent and engineering employment 63 per cent of the 1929 figures, as compared with corresponding percentages of 23 and 47, respectively, in the industrial machinery group.

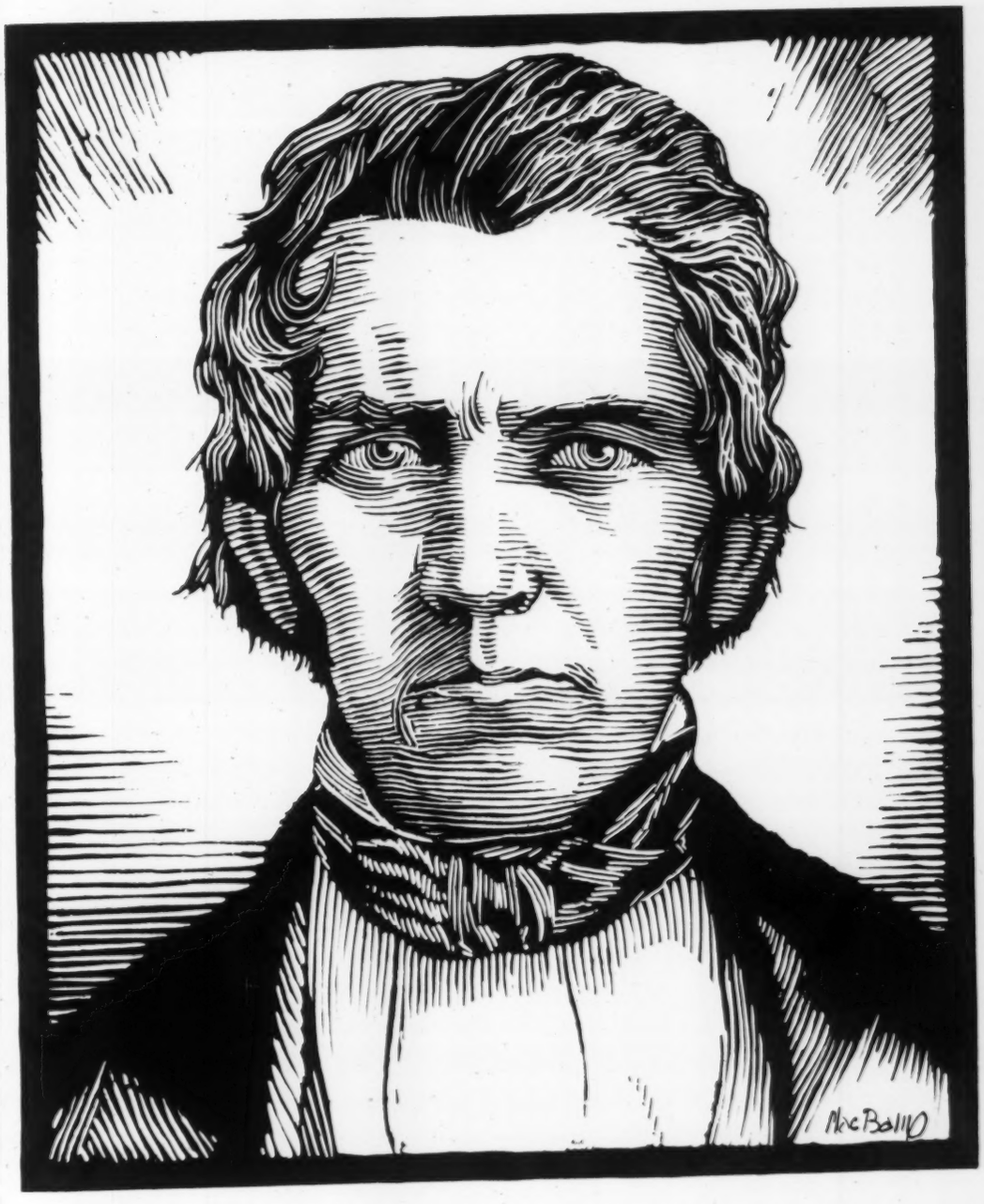
Two conclusions are obvious. First, in the aggregate a fair volume of machinery business still exists. Secondly, engineering activity is being maintained at a rate almost twice that of actual production—which fact is a fine commentary on management's recognition of the efficacy of good engineering and design.

Single or Multiple Unit Machines?

ARE we to see temporary cessation in design of multiple production machinery? For years manufacturers of stockings have installed increasingly larger machines of the multiple type, the latest being capable of knitting 24 stocking legs at one time. Yet one hosiery machine builder at least has introduced a new single unit machine recently.

It might be said of any multiple production machine that there is much more likelihood of stoppage than with a single unit machine; and that in this even production would be tied up seriously due to the necessary shutting down of the other units.

There appears, however, to be another reason for present development of smaller machines—flexibility of production. Manufacturing runs are shorter. If multiple production machines are to be discredited on account of the possibility of breakdown, the time is ripe for designers to put intensive thought into solving this problem, rather than to go back 30 or 40 years to the single unit machine.



Thomas Davenport

Master Designers

Thomas Davenport

MANY inventions have been conceived by men who knew little about the forces with which they were working, but history does not record any development more amazing than that made by Thomas Davenport, the Brandon Blacksmith. This man, born in Williamstown, Vt., in 1802, did not read or hear about, experiment with, or see the workings of electricity until he began his development. Then, starting with an electro-magnet energized by a galvanic cell, he produced the original invention of the electric motor.

DAVENPORT'S conception was far in advance of the times. His patent, No. 132 granted in 1837, would cover every electric motor built if it were in force today. Intensely religious and rabidly patriotic, Davenport enjoyed the meagre educational advantages of those early days, but did not have available records of scientific principles, previous invention or current discovery. Orphaned at an early age, he was apprenticed to a blacksmith and at 21 set up his own shop.

A DREAMER and a thinker, Davenport was not destined to spend much time as a blacksmith. Word was carried through the mountains that Professor Joseph Henry had invented an electro-magnet that would lift a blacksmith's anvil. Davenport went to inspect this magnet, saw the possibility of making and breaking the current, scraped up the necessary money and carried the device home with him. On this day the electric motor was born.

FINANCIAL difficulties and lack of materials hampered the development, but the motor was eventually completed. These experiments led to others and Davenport built a practical model of an electric train and constructed a working telegraph set some time before Morse announced his development. It is said that disappointment and privation were the cause of Davenport's death at 49. Yet he has gone down in history as one of the first to apply electro-dynamic force for the propulsion of a mechanism which does mechanical work at the expense of electrical energy.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Welcomes Letters or Solutions to Problems Suitable for Publication

Employs Simple Reversing Mechanism

To the Editor:

AS ROTARY reversing movements of a shaft usually require a complicated mechanism, it may be worth while to offer a simple means of accomplishing this action. One type of spinning machine required movement of this sort. The movement of the machine shaft in the counterclockwise direction is succeeded by a dwell, and its movement in the clockwise direction by a relatively shorter dwell. In addition, the velocity of the latter movement is one-half the velocity in the counterclockwise direction. The simple action of this ingenious mechanism makes the design suitable for various similar applications.

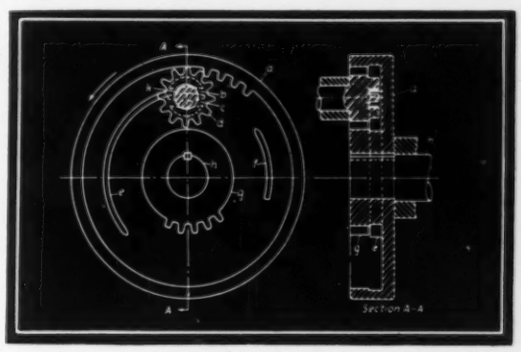
Unusual Action Obtained

The unusual action is obtained by means of the arrangement shown in the sketch. Ring *a*, containing four gear teeth, is the driving member and is keyed to the drive shaft *h* running in a stationary bearing. Cast integral with this ring is the hub *g* containing five teeth, one of which has been abbreviated. The teeth in both the ring and its hub alternately engage the pinion *d* on the end of the driven shaft *k* which is supported in a stationary bearing. In the end of the pinion are cut two circular slots which alternately engage one of the two guide rails *e* and *f* cast on the web of the ring.

The end of guide rail *e* has just left the slot *b* in the pinion so that the pinion is free to revolve. When the driving ring rotates in the direction of the arrow its teeth engage those of the pinion causing the latter to rotate one-half revolution. At the end of this movement the pinion slot *c* is aligned with guide rail *f* so that continued rotation of the ring will cause this rail to enter the slot and lock the pinion, dwelling the latter. This dwell continues until the end of the rail passes out of the slot at which time the first tooth in hub *g* engages a tooth in the pinion; and as the ring continues its rotation this gear is revolved one-half revolution in the opposite direction.

At the end of this movement slot *b* is in alignment with guide rail *e* which locks the gear just as did rail *f*. This dwell however is considerably longer than that imparted by rail *f*, continuing until the ring is once more in the position shown. This ends one cycle. As the ring rotates continuously these movements are repeated successively.

The reduced length of a tooth was necessary to limit rotation of the pinion to one-half a revolution and incidentally to permit this tooth to clear the teeth in the pinion when the latter was locked in its dwelling position by rail *e*.



Rotary reversing movements of a shaft are made available through simple mechanism which can be adjusted for various periods

By modifying this design, that is by varying the length of the guide rails and the number of teeth in the ring and hub, various dwelling periods and angular movements of the pinion can be obtained.

—E. F. EBERHARD,
Bridgeport, Conn.

Designing for Style

To the Editor:

SOME very convincing evidence that designing machinery and equipment for good appearance is good engineering was contributed by George C. Lawrie in his article "Designing for

Style Plus Mechanical Perfection" in the March issue of MACHINE DESIGN. This excellent article has prompted the following thoughts which may be of interest to other readers.

A coupon for a precision tension or fatigue test has pleasing appearance—a neatly polished surface and pleasing sweeps of contour. It is of course true that there is not the slightest reason in the world why a test coupon should be made to have good appearance, yet all precision test coupons have this property. From the artistic point of view the reason is perfectly simple. The precision test coupons are made mathematically correct for the purpose for which they are intended. Mathematical correctness is a definition of beauty.

Refined Mathematical Correctness

Mr. Lawrie started out on a deliberate program to improve the appearance of Riehle testing machines. What he actually did was to refine and more nearly reach mathematical correctness of design with reference to the utility of the machines in a broader sense than had been considered before. He achieved a satisfying result by a process which is quite analogous to the way in which precision test coupons acquire pleasing appearance.

Such satisfying results are quite different from attempts to improve the appearance of machinery by methods based on less fundamental premises. Most agricultural machinery manufacturers exhaust their resources in this latter direction completely when they apply generous amounts of bright red and blue paint. "Pretty as a red wagon" is the nonmathematical yardstick for measuring pleasing appearance in many lines of machinery and equipment. Mathematical correctness is a gage which yields far more satisfying results, even in terms of sales and profits.

—ROBT. E. KINKEAD,
Shaker Heights, O.

Perfect Patent Agreements!

To the Editor:

RECENTLY, an engineering employe made an invention and divulged enough of it to his employer to influence him to make patent application covering the idea. Assignment papers were prepared by the employer's patent attorney, but the employe refused to sign them until a previous promise for a salary increase contingent upon finding a solution to the problem was made good. Some months passed, the employer refusing to carry out his promise, then suddenly the employe left, but before leaving he sold the ideas involved to the employer's worst competitor, one of whose men immediately made patent application. About six months later an employe of the first named employer made application for the identical ideas in his own name.

Patent Interference Declared

The Patent Office declared an interference, and in the course of the testimony it developed that neither of the applicants was the original inventor but that both were, in reality, perjurers. The case finally was thrown out of court and after much incidental trouble the embarrassed lawyers of both sides got together and secured an enormous fee for agreeing not to prosecute the case.

All that trouble on account of a salary increase. This treatment of employes is so common that not long ago the chief engineer of an important corporation was asked by one of his men if it paid to give up one's patent rights to an employer. He was told that the advisability of giving patent rights was a matter for him to decide and to use his best judgment whether it would advance him professionally. The answer was the truth—for that office. The employe left soon thereafter and gave valuable patent rights to another company, a competitor. The question is: "Was the chief engineer unfaithful to his duties as engineering representative of the employer, who probably would have used all means to get from the employe any inventions or details thereof?" Another question is, "Is it fair to encourage employes to give up their rights as inventors when the executive knows there is no hope of fee or reward?"

Should Give Employer Results

My personal experience is that it pays to give an employer any and all inventions one may make while in his employ; first, because the employe under most conditions can be forced in one or more ways to make an assignment to the employer and an employe is obliged always to refer to the former employer in case of looking for another position, so it is best to keep up cordial relations. Secondly, the employe gets considerable favorable advertising out of the issued patent and in many cases it leads to an offer from another company at advanced salary and position.

—JOHN S. CARPENTER,
York, Pa.

Editor's Note: Mr. Carpenter overlooks the possibility of equitable patent agreements being signed by employer and employe. This is one recognized method of obviating the difficulties he mentions.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

Cast Iron Replaces Steel for Shafts In Automotive Engine Design

RUMOR has it that Ford is considering a nickel cast iron crankshaft. This throws a timely sidelight on the recent discussion by T. H. Wickenden in which he points out that industry in general and the automotive branch in particular has been following with keen interest a recent noteworthy development involving a radical departure from engineering tradition—a trend toward cast iron camshafts and crankshafts.

While cast iron has been used for various types of cams for many years, most of the applications have been on relatively slow speed machinery as compared with the modern automotive engine. Such cams were made of gray iron with an attempt to adjust the composition to give the highest machinable hardness. Trouble was experienced and the solution to this problem by the use of nickel alloy cast iron was one of the early successes of alloyed material.

* * *

Rotary Process Employed to Produce New Nondendritic Steel

STEEL so closely grained as to be practically free from all banding and directional properties in the cast and rolled states soon will be available on a commercial scale. This announcement bears a significant relation to the design of machinery of which steel has been a constant companion in the march of progress. H. M. Naugle and A. J. Townsend, collaborators on the development, created this process for making nondendritic steel to which research long has aspired and which is so revolutionary that it is practically unknown except as a laboratory product.

The method of producing the new material eliminates the orthodox ingot casting and blooming operations. One hundred per cent steel scrap is charged into an electric furnace; the melt is poured quickly into a mold revolving at high speed; the resulting circular two-ton bloom, 7 by 7 inches in cross section and 10 feet in diameter, is sheared into the required number of arcuated sections; a flash heat brings these sections up to rolling temperature, preparing them for billet conversion on a 3-high breakdown mill.

First form in which the new steel is to be produced and marketed will be cold drawn bars of standard analysis. A plant now is under construction at Detroit by the Rotary Electric Steel Co. (Michigan) with an estimated monthly capacity of 7500 tons.

* * *

Textile Unit Indicative of Trend Toward Single Unit Machines

DURING recent months there has been considerable discussion on the return to single unit machines in manufacturing. This may constitute a design trend in the elimination of multiple units which were created to increase production per worker. In the hosiery industry particularly, large multiple unit knitting machines have been adopted in the past to produce 24 legs or feet. Recently, however, a new unit which knits but one stocking was introduced. The announcement has caused wide comment.

While one knitter is able to attend the multiple machine with comparative ease, it is obvious that when the machine stops work on all 24 stockings ceases. With a single unit machine this does not happen . . . 23 other stockings still continue to be made. In addition the single machine is capable of being made of lighter parts and therefore will operate faster.

* * *

Proposes Business Reconstruction Plan Embodying Prompt Direct Action

IN VIEW of the wide and important need for business reconstruction it is interesting to study a recently proposed plan embodying control of production and distribution by prompt direct action. Suggested by George P. Torrence, president, Link-Belt Co., Chicago, the recommendations setting forth his ideas reflect

(*Concluded on Page* 46)

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

PERSISTENCE and the part it plays in development is exemplified by the career of Dr. Edward Weston, founder of the Weston Electrical Instrument Co. An excerpt from his early record reveals that he encountered great difficulty in making the necessary electrical measurements with the clumsy, slow-acting instruments then available. Consequently, he designed and built for his own experiments, a set of more practical instruments.

Now at the age of 82 he looks back on wide achievement. Many honors have come to him including the award of the Lamme medal of the American Institute of Electrical Engineers recently announced. His formal education was obtained in England, where he was born May 9, 1850 near Oswestry, Shropshire. He came to New York in 1870.

Although the dynamo had been invented some years earlier it had not come into practical use, placing serious limitations on development of plating processes for which batteries were used. Dr. Weston, therefore, began the study and construction of dynamo-electric machines. He filed his first application for a patent in 1876, and later received many patents in that field. He also invented new devices for starting, controlling and protecting them. Dr. Weston became chairman of the board of his company in 1924, a position he still holds.

EXECUTIVE capacities await those engineers who will train themselves in a broader understanding of management as it pertains to the fundamentals of design and engineering. Organizations offer a wide latitude of accomplishment in this direction. Just recently for instance, J. M. Hipple, who began as a testing engineer, later becoming a designer, was appointed general manager of merchandising engineering of Westinghouse Electric & Mfg. Co. In this position he will have charge of the appliance and refrigeration engineering departments, and in addition the radio engineering at Chicopee Falls Works, the small motor engineering at East Springfield Works, and the industrial heating engineering division at the Mansfield Works.

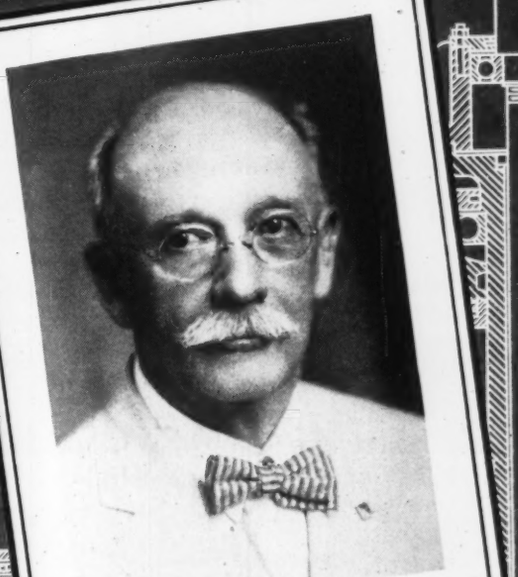
Born in Jefferson, O., in 1877, Mr. Hipple received his early education there. In 1898 he was graduated from Ohio State university with the degree of mechanical engineer in electrical engineering. It was at that time that he joined his present organization. After one year designing transformers, he worked from 1900 to 1911 on direct current motor design and was made manager of the motor engineering department. In this capacity he had charge of the design of all industrial apparatus, including alternating current motor, controllers, etc. From September 1927 to June 1931 he was works manager of the East Pittsburgh plant, becoming general works manager at the latter date.

TO HIS new post as assistant chief engineer Richard A. North brings a diversified experience in various phases of mechanical engineering and industrial management. Through several years of collegiate teaching and association with prominent firms in the manufacturing and transportation fields he has acquired a knowledge which fits him particularly for his new work in the Farrel-Birmingham Co. Inc., Ansonia, Conn.

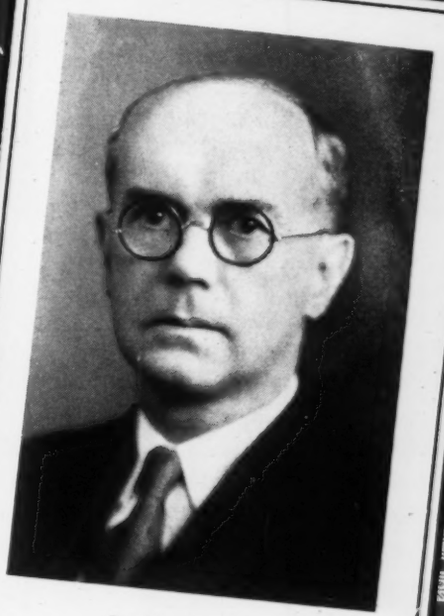
Born in New Haven, Conn., he attended public school there and prepared for college at the Hotchkiss School, Lakeville, Conn. After graduation from Sheffield Scientific school of Yale university he entered the research department of the Barrett Co., Edgewater, N. J., as research engineer. A year later he returned to Yale as instructor in mechanical engineering and also to do graduate work for which he received the degree of mechanical engineer. Mr. North continued on the teaching staff for six years, conducting courses in mechanical technology, mechanisms, hydraulic machinery, industrial heating, mechanical processes and management.

UNFLAGGING energy and enthusiasm are marked characteristics of Dr. Frederick M. Becket. Moreover, he has the additional quality, so rare in inventors, of an economic sense of direction. With these guiding forces he takes the post of president of the American Institute of Mining and Metallurgical Engineers. He is just

Leaders in Design, Engineering and Research

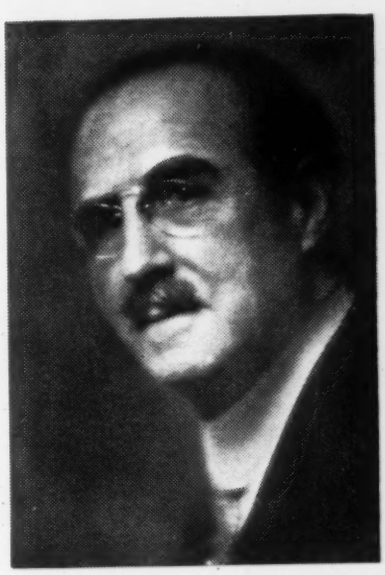


EDWARD WESTON



J. M. HIPPLE

RICHARD A. NORTH



FREDERICK M. BECKET

the right type for this work, his colleagues say, and his kindly personality, wide sympathies and interests will play no small part in his new capacity.

Metallurgy claims him professionally. Born in Montreal, Canada, he was graduated from McGill university, with a subsequent doctor's degree. Soon after he left school he came to the United States. With Westinghouse he launched himself in the electro-chemical and electro-metallurgical industry, in which during the past 37 years he has grown to be a prominent figure.

During his early career he found time to work for a master's degree at Columbia and spent several years in post graduate work at that university. Upon completing the course, he organized in 1903 the Niagara Research Laboratories, and has been with that company and its successors ever since. It was purchased in 1907 by the Electro Metallurgical Co., which now is a unit in the Union Carbide and Carbon Corp., of which Dr. Becket is vice president. He holds the same office in the Electro Metallurgical and Haynes Stellite companies, and is president of the Union Carbide and Carbon Research Laboratories Inc.

* * *

Lionel S. Marks, professor of mechanical engineering at Harvard university, recently received one of the 47 Milton awards conferred for research work. Prof. Marks, known widely for his mechanical engineer's handbook, was assigned the fellowship for an investigation of the influence of discharge ducts on the performance of fans.

* * *

Henry S. Beal, former general manager of the Jones & Lamson Machine Co., Springfield, Vt., has been made president of the Sullivan Machinery Co., Chicago. A picture and biographical sketch of Mr. Beal appeared in the November issue of MACHINE DESIGN.

* * *

Rudolph Furrer, formerly chief engineer and director of research of the A. O. Smith Corp., Milwaukee, and also previously engineer for the Allis-Chalmers Mfg. Co., Milwaukee, has been appointed assistant to the operating vice president of the National Tube Co., Pittsburgh. Mr. Furrer will further extend National Tube Co.'s research and engineering studies in his new capacity.

* * *

Dr. Vsevolod N. Krivobok, professor of metallurgy, Carnegie Institute of Technology, Pittsburgh, will deliver the Campbell Memorial lecture during the 1934 annual convention of the American Society for Steel Treating. Dr. Krivobok has been connected with the Institute for the past 8 years and as a member of the research staff of the bureau of metallurgical research has worked principally with stainless and heat-resisting steels.

* * *

Prof. Elihu Thomson, pioneer of the electrical industry (M. D., Nov. 1930) and one of the founders of the General Electric Co., was honored at a public dinner at the Massachusetts Institute of Technology, Cambridge, Mass., on March 29, his eightieth birthday.

* * *

George W. Fuller, consulting engineer, Fuller & McClintock, New York, has been elected chairman of the Engineering Foundation to succeed H. Hobart Porter. H. P. Charlesworth, vice president Bell Telephone Laboratories Inc., (M. D., Feb. 1932) is first vice president of the organization.

* * *

E. A. Muller, president of the King Machine Tool Co., Cincinnati, and first vice president of the National Machine Tool Builders' association, Cleveland, has assumed the duties of the presidency under the provision of the association's constitution, succeeding Henry S. Beal, who has retired because of his withdrawal from the machine tool industry.

Obituaries

CHARLES MacCAUGHEY SAMES, since 1916 associate editor of the American Society of Mechanical Engineers, died at New York March 8. A graduate of Rose Polytechnic institute in 1886, he joined the Thomson-Houston Electric Co., returning in 1887 to his native town of Rochester, Ill., to enter business with his father, a manufacturer of agricultural implements. In 1905 he compiled and edited a "Pocket Book of Mechanical Engineering," and thereafter was identified with association and publishing activity.

* * *

Frank Horsburgh, 78, president, Horsburgh & Scott Co., Cleveland, died recently. A native of Scotland, Mr. Horsburgh went to Cleveland when 25. In 1888 he entered into partnership with Thomas Scott, doing business as general millwrights and machinists. When electric street cars were introduced, gears were manufactured. In 1888 Mr. Horsburgh bought Mr. Scott's interest. He was a founder of the American Gear Manufacturers' association.

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

SUGGESTION for ideas pertaining to cushioning devices may be found in a new unit employed to support truck bolsters of railway cars. The designer is Donald F. Sproul, Chicago, with the Cardwell Westinghouse Co. as assignee. In this invention, designated patent No. 1,894,717, friction and springs are employed to secure smooth action and durability.

Study of the construction, Fig. 1, reveals a pair of followers, 10, 11, adapted to seat on the lower arch of the truck frame. A powerful helical spring 12 is interposed between the two followers, being of sufficient diameter to enclose the remaining elements of the device. These parts include a rotatable shaft 13, the lower end of which projects into a socket formed in a boss 14. The inner end of the boss is flat to provide a bearing surface upon which radial flange 15 of the shaft 13 seats and may turn.

Above the flange the shaft is threaded as shown at 16. The threaded end of the shaft extends into barrel 17 which is integral with follower 11. A helical spring 19 surrounds the shaft and barrel, its ends 20 and 21 being anchored in sockets 22 and 23, respectively, in flange 15 and follower 11. Under compression the two followers approach each other against the resistance of spring 12. Shaft 13 advances into barrel 17, and in turning winds up spring

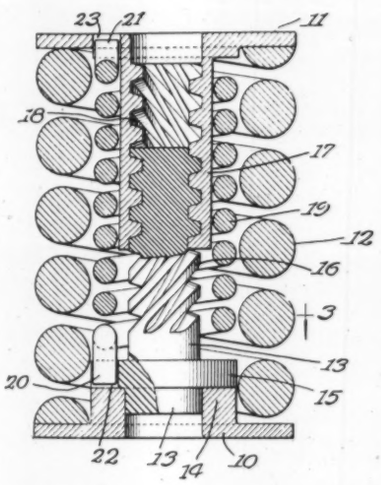


Fig. 1—Shock and violent recoil are prevented by a comparatively slow movement of the screw retarded by friction between the shaft flange and follower boss, and also between the screw threads

19. Friction is developed between flange 15 and bearing face of boss 14; also between the threads of the shaft and barrel. When compression is relieved the parts are restored to normal position, primarily by expansion of spring 12 and the unwinding of spring 19. A too violent recoil is prevented by the slow movement of the screw as well as by the friction between the shaft flange and the follower boss and also by that which prevails between the screw threads.

PREVENTION of leakage is one of the major problems in designing grease guns. One method of construction which allays this obstacle has been developed by Oscar U. Zerk for the Alemite Corp., Chicago. A ball and socket joint providing universal movement is employed in connection with a tightly wound helical spring designated 23 in Fig. 2. This spring, fitted tightly in the reduced tubular end 11 of the element 10, projects through packing 21.

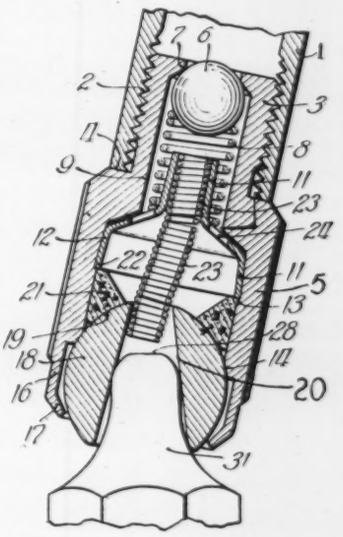


Fig. 2—A resilient tubular member which may be a closely wound helical spring forms an important part of a self-centering universally movable nozzle for lubricating apparatus

When the gun is presented to nipple 25, nozzle 18 normally will be positioned with the axis of recess 20 coaxial with the gun by the retractive action of the resilient conduit or spring 23. For convenience and to render the operation of the gun efficient, it may be rocked through an angle out of line with the nipple to clear the gun from any projecting portion of a machine. As it rocks, the packing element 21 maintains its sealing contact with spherical surface 19. Also the spring, as shown in Fig. 2, will be bent laterally out of its straight line position.

The gun now may be operated to force lubricant through nose 5. Pressure will move valve 6 from its seat and permit lubricant to flow

through spring 23 and also through aperatures 24, thence into nozzle bore 20, and the nipple with which it is in sealed communication. The patent has been designated No. 1,899,071.

TO MINIMIZE the load on the prime mover of a compressor during the starting and stopping periods of the compressor an unloader has been devised by John LeValley. The type of unit for which this unloader is designed is shown in Fig. 3, comprising a crankcase *B* on which is mounted low and high pressure cylinders *C* and *D*, respectively. Fig. 4 is a longitudinal section arranged diagrammatically. Ingersoll-Rand Co., Jersey City, N. J. has been assigned the patent which is designated No. 1,899,002.

In the operation of compressor of this type and particularly where it is being driven by a prime mover having a low starting torque, it is desirable that the prime mover be relieved of the heavy load resulting from starting the mechanism against compression. The apparatus is provided with relief devices adapted to unload the compressor during speeds of operation which are below the normal operating speed.

The medium to be compressed enters head *E*, Fig. 3, through inlet *Q*, thence flows through inlet valve *G* into cylinder *C*. There it is compressed by piston *T* and expelled through discharge valve *H* into intercooler *J*. Subsequently the fluid passes into cylinder *D* where it is compressed to a higher value by piston *U*, being expelled through the discharge valve *H* in head *F* and through outlet opening *S* to its destination.

During normal operation a portion of the fluid compressed in cylinder *D* will pass through passages *d*, *c*, valve chamber 9, the passage 14 and 13 and through pipe *Z* into passage *q* where it

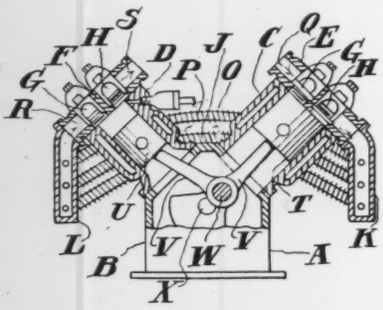


Fig. 3—Multiple cylinder compressor to which an unloader is applied for minimizing the load on the prime mover during starting and stopping periods

will act against ball valve *o*. With the compressor operating at normal speed weights 6 will be rocked outwardly by centrifugal force and hooks 8 associated with weights 6 then will act against plunger 4 and depress spring 5 to such degree that pin *y* may be displaced readily by the pressure of the air acting against ball valve *o* so that the valve will seat upon *s*, thus cutting off communication between cylinder *D* and the atmosphere. After the ball valve reaches this closed position pressure fluid will accumulate in pipe *Z* until it reaches a value equal to that of

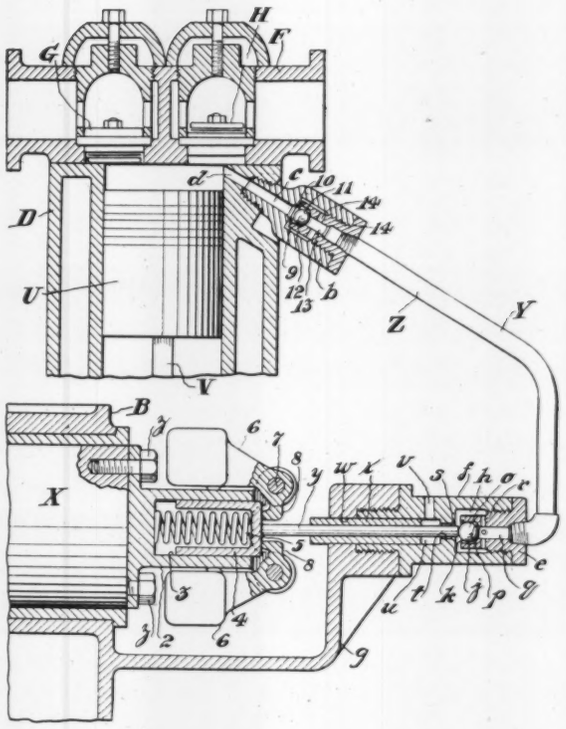


Fig. 4—Spring pressure is employed to overcome force of weights to keep valve open to atmosphere

the fluid compressed in cylinder *D*. During starting and stopping of the compressor spring 5 will exert sufficient pressure upon plunger 4 to overcome the force of weights 6. Valve *o* then will be operated to its open position, allowing the pressure in the passages to have excess to the atmosphere.

Review of Noteworthy Patents

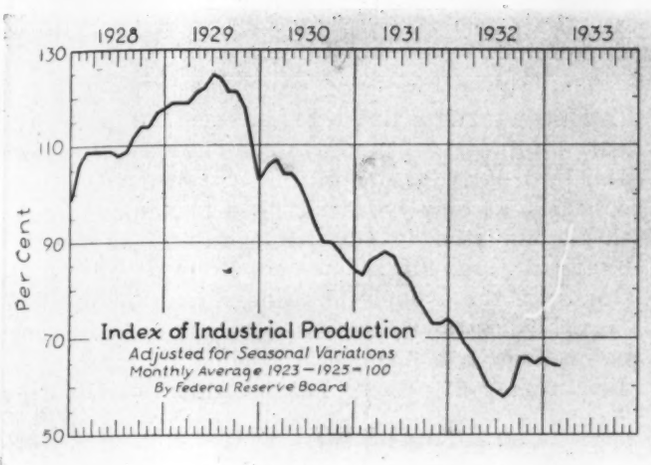
Other patents pertaining to design are briefly described as follows:

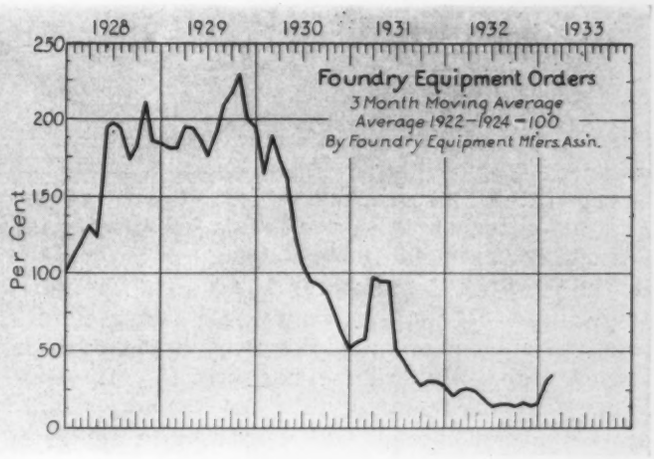
BEARINGS—1,897,771—Guide bearings for reciprocating units are covered by this patent. These bearings apply particularly to crankless engines. Michell-Crankless Engines Corp., New York, is assignee.

VACUUM PUMP—1,890,574—It is the object of this invention to provide a simple and effective backing pump in combination with a high vacuum stage and to combine the two so that the backing pump becomes a fore-stage for the high vacuum cylinder, and to do this without increasing the number of parts required. Assigned to Central Scientific Co., Chicago.

REMOTE CONTROL UNIT—1,899,151,—Although the patent description of this device treats of application to a radio mast the inventors state that it may be applied equally well to other rotary members to permit adjustment from a remote control station. Assigned to Woodstock Typewriter Co., Woodstock, Ill.

CENTRIFUGAL FLEXIBLE COUPLING—1,898,806—This invention relates to a device for connecting driving and driven members where it is necessary to compensate for sudden changes in speed and torque. Centrifugal elements are employed to balance the torque demanded by the load. Assigned to Black & Decker Mfg. Co., Towson, Md.



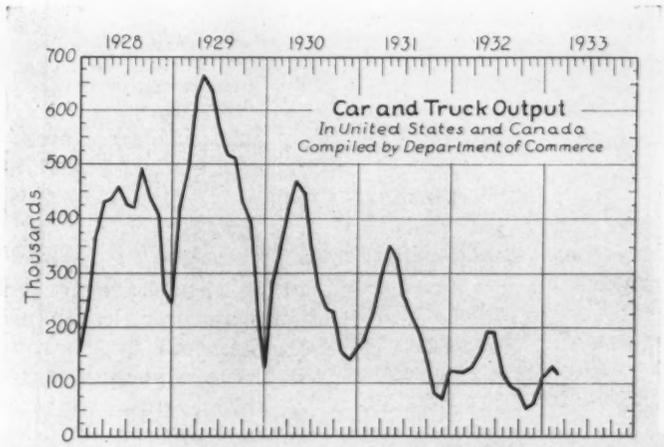


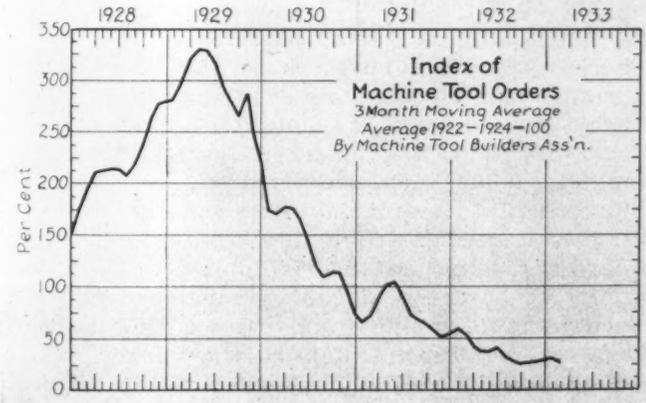
How Is Business?

THIS is the bottom." With these few words Secretary of the Treasury Woodin placed the stamp of authority on the hopes of millions of his fellow citizens. The turning point has been predicted many times, often in ambiguous terms which left their creator free to claim misinterpretation. Now, for the first time important leaders have irrevocably stated that the long decline has ended.

For many, the necessity of stopping the game, counting the chips, and reorganizing was particularly onerous, yet the prompt, decisive, history-making action of the country's new executives, and the wholesome spirit with which business leaders and all citizens have accepted conditions and tackled strange problems indicate that this most necessary housecleaning has done more than set the books straight—it has recreated the pioneer spirit of facing the facts and working with a smile toward the clearing up of conditions.

The pause naturally pushed down already depressed business indexes. Lack of cash and the uncertainty prevalent during the early days of the crisis brought about the cancellation of orders, inability to take up commitments, and extreme reluctance to place future business. However, the net effect of the retardation was to increase the already enormous deficiency in machines and materials, a deficiency that must be made up in the future. Obsolescence, rust, depreciation and the creation of ideas did not stop merely because the banks were closed and cash was scarce.





TOPICS OF THE MONTH

(*Concluded from Page* 39)

sound thinking on the subject. Agriculture gets attention early in the thesis because in its various forms is the largest business enterprise in the country. A dictator is required, he contends, and his suggestion entails the appointment of such a man by the President for each major crop. Experience has proved, Mr. Torrence further declares, that the farmers themselves cannot compel the reduction in acreage. Each dictator would be given the authority to limit the amount of land intended for any crop to some fixed percentage of a five year average for each farm.

Raw material industries, he says, are as much in need of firm handling as agriculture, and properly governed, the benefit to the general public would be great. As in the case of agriculture, prices are controlled largely by supply and demand. To conserve a national resource and avoid the waste now existing, the oil industry should be given a chance to regulate itself legally under federal commission supervision. The only manufacturing industry that should be included at once is steel and iron; this because it is the greatest basic manufacturing industry and affects a large number of other industries.

* * *

Socket Type Set and Cap Screws Are Covered by Proposed Standard

A TENTATIVE draft of the proposed American Standard for socket type set and cap screws has been completed by subcommittee No. 9 of the sectional committee on standardization of bolt, nut and rivet proportions of the American Standards association. The project is under the sponsorship of American Society of Mechanical Engineers and Society for Automotive Engineers.

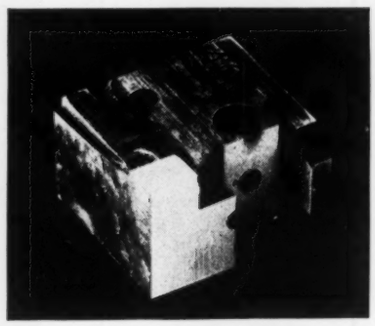
The standard as proposed includes both set and cap screws with hexagon and fluted type sockets together with wrenches for both types. Detail dimensions and tolerances are tabulated, and the range of sizes included covers from No. 5 to 2-inch for the set screws and from No. 8 to 1½-inch for the cap screws. In the notes under the tables the series of standard lengths for each size of screw is specified.

Six designs of point, cup, flat, oval, cone, full dog and half dog are proposed as standard for the set screws, a chamfer of 35 degrees is specified for the cap screw points and the threaded length of the cap screws is given for both National Coarse and National Fine Screw Thread Series.

The dimensions and tolerances covered by this standard will be of interest to all users and manufacturers of the socket type screws and in order that, when finally approved, it may conform as closely as possible to requirements, the committee is soliciting advice as to any changes that might be considered advisable. Copies of the proposed standard may be obtained from Herman Koester, chairman of the subcommittee, c/o American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York.

Hard Facing Increases Life of Monotype Molds

INCREASED length of life of monotype molds has resulted from hard-surfacing methods used to reduce wear from abrasion. In forming individual type, molten type metal is forced into the mold, three sides of which are formed by three steel blocks, one being shown in the accompanying illustration. The matrix, in which the character on top of the type is cast, seats against the opening formed by these three blocks. As type are cast at the rate of two or three a second, the matrix is correspondingly lifted and seated under spring pressure against the raised hard-surfaced portions on the upper surface of the mold.



Hard-surfacing of contact areas increases service life of monotype mold

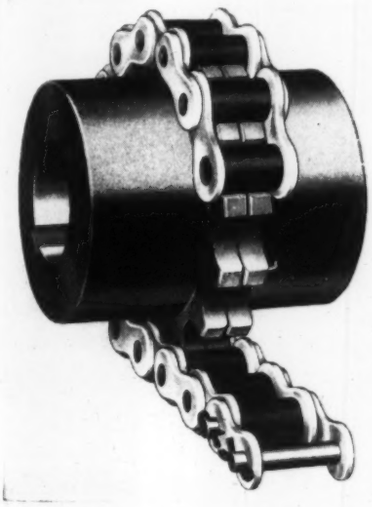
These slightly raised portions of the blocks, horizontal white surfaces in the illustrations, protect the blocks from wearing down. It is necessary to keep the height of type very accurate and wear on these blocks of approximately 0.002 inch usually requires their replacement to maintain this accuracy. According to a recent article in *Oxy-Acetylene Tips*, hard-surfacing material is applied to the raised portions of these blocks by means of the oxy-acetylene blowpipe to give a coating approximately 0.030-inch thick at the corner of two of the blocks and at the center of the third.

NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Introduces New Flexible Coupling

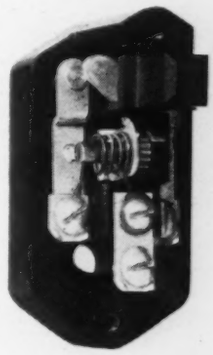
CONSISTING simply of two cut-tooth sprocket wheels (or coupling halves) and a piece of roller chain to connect them, all working surfaces being machined to close tolerances, the new flexible coupling announced by Link-Belt Co., Indianapolis, employs the recently introduced Silverlink roller chain manufactured by the company. A pin-and-cotter link on the chain, shown herewith, makes it possible to couple or remove the chain easily whenever desired. Where the operating conditions suggest the advisability of protection from dust, dirt or other adverse conditions, the coupling can be enclosed in either a stationary or revolving oil-retaining casing which is lubricated automatically.



Pin-and-cotter link on chain used with new coupling makes it possible to couple or remove the chain easily whenever desired

Breaker Protects Small Motors

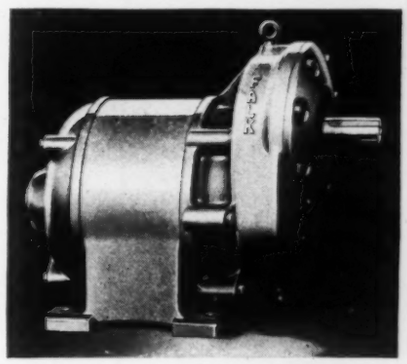
FOR the overload protection of fractional horsepower single phase motors, Square D Co., Industrial Controller division, Milwaukee, offers the new Knockout overload breaker. The unit, shown herewith, is designed to mount on and wire into a standard ½-inch knockout. The case is of bakelite and overall dimensions are 2-7/16 inches high, 1⅜ inches wide and 1¾ inches deep. Breakers are of the thermal, melting alloy type. After an overload trips the breaker, it is reset from an indicating button; no replacement parts are required. Contacts are silver to silver, single pole, double break. The maximum rating is ¾-horsepower, 110 or 220 volts, alternating current. Designation is Class 9020, Type W 10.



Overload protection is provided by breakers which are reset from an indicating button. No replacement parts are required

Reducers Designed for Low Ratios

BOTH speed reduction and speed increase are obtainable with geared-head motoreducers especially designed for relatively low ratios by Falk Corp., Milwaukee. These units, shown herewith, are a combination of motor and gear unit and make possible the use of high speed

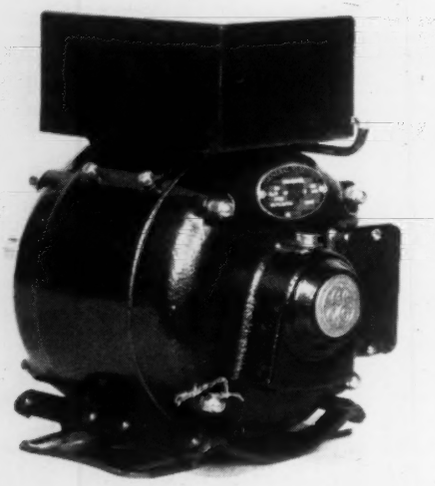


Variations of speed secured with units in line of geared head motors ranges from 1/9 to 2½ times motor speed

motors. Variation of speed secured with a single-pair gear train ranges from one-ninth motor speed to about 2½ times motor speed in the various units in the line.

End Flanges Shield New Motors

FOREIGN material is kept from dropping into the motor by new end flanges on the improved capacitor motor for refrigerator applications developed by General Electric Co., Schenectady, N. Y. A new terminal box, designed primarily for convenience in making connections, is cast in one end flange. Direction of rotation of the motor, shown herewith, may be changed by interchanging the motor leads at the terminals.

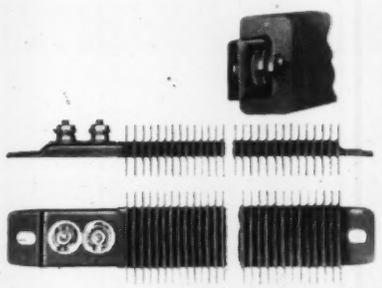


Terminal box on new capacitor motor is cast in one end flange

Improvements in the bearings of the motor have doubled its oil capacity. All of the oil is held in suspension in the wool yarn with which the bearings are filled. A device is built into the end flanges to cushion automatically any longitudinal movement of the rotor. The capacitor is substantially smaller than previous units which increases the adaptability and improves the appearance of the motor. An all-steel spring base furnishes a resilient mounting.

Strip Heaters Have High Efficiency

SPECIALLY rated strip heaters to which are attached fins of rust-resisting iron, copper or heat-resisting stainless steel have been developed by Edwin L. Wiegand Co., 7500 Thomas boulevard, Pittsburgh, for use in heating equipment and general heating applications. Approximately five fins are used per lineal inch of heated length. The extended area of fins allows high strip heater wattage ratings at low wattages per square inch of strip surface. Light weight of the units prevents over-run and lag in temperature where automatic control is used.



Extended area of fins allows high strip heater wattage rating at low wattages per square inch of strip surface on new electric heating

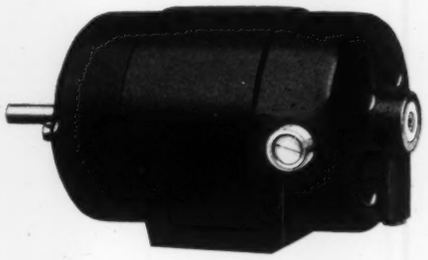
Cord Is of Rubber Construction

DEVELOPED for use in all places where easily frayed or spotted textile covered lamp cord cannot be used satisfactorily, a new approved rubber-sheathed cord announced by Belden Mfg. Co., 4689 West Van Buren street, Chicago, has received Underwriters' approval. The cord, shown herewith, will be sold under the name of "No-Fray" and will carry the Underwriters' 5-foot safety label. It is of all-rubber construction and is available in brown or black.

Rubber sheathed cord will not fray

Three Universal Motors Developed

THREE new designs of universal motors have been added to the line manufactured by Dumore Co., Racine, Wis. The K-3 type, shown herewith, is a series universal motor designed for applications where especially high performance is required. Ratings for this model are: 30 minute rating at 5500 R.P.M.—



Series universal motor is adapted especially to the operation of portable electric tools and equipment

LET GILMER ENGINEERS HELP YOU DESIGN A BETTER V-DRIVE . . . .

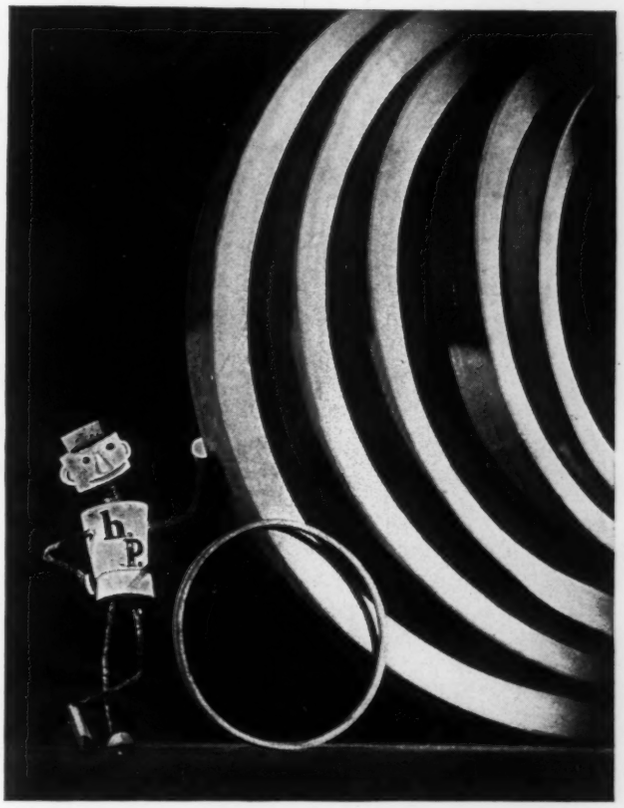
With a background of 30 years' experience in making endless belts, Gilmer Engineers can assist you in designing *better* V-drives. They will show you how to obtain maximum power with minimum wastage, and longer, more economical service from your V-drives — on all sizes — from the Fractional Horsepower Drive to the Multi-V-Drive with hundreds of horsepower.

By specifying Gilmer V-Belts, you will greatly increase the efficiency of your machines and reduce the cost of operation and servicing. Gilmer V-Belts are built to stand up under the severest requirements—to give economical service over a long period of years.

There are standard stock belts to accurately fit all sizes and makes of V-drives.

Many firms, both here and abroad, have taken advantage of Gilmer's free engineering service and now have more efficient and economical V-drives. For further information on this free service — and a free copy of The Gilmer V-Drive Hand Book —

Gilmer BELTS



The character "H. P." appearing in Gilmer Belt advertising was created to symbolize horsepower. Gilmer Engineers have always specialized in power transmission belts. They originated the endless fabric belt; perfected the V-Belt for fractional and multiple drives; developed a new rubber-and-fabric round belt, and during 1932 introduced the new revolutionary flat belt —Kable Kord for flat pulleys. Each one of these belts performs a definite job in transmitting horsepower, each has its special part to play in industry — but all have one definite purpose — the economical transmission of horsepower.

MAIL THIS COUPON

L. H. GILMER COMPANY
7248 Keystone Street
Tacony, Philadelphia

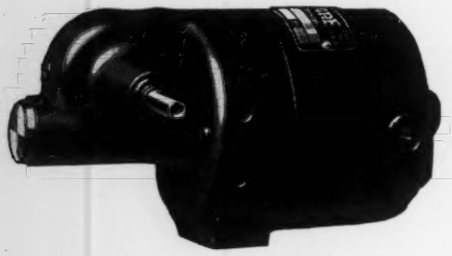
Without obligation, please send me a free copy of The Gilmer V-Drive Hand Book and complete information on Gilmer's free engineering service.

Name_____

Firm_____

Address_____

1/6 horsepower; continuous duty at 6500 R.P.M. —1/8 horsepower. The J-3 model is the same as K-3 except in the design of housing and ventilation. These motors are adapted especially to operate electrical tools such as portable drills, saws, routers, grooving machines and sanders, and such appliances as vacuum cleaners, floor polishers, portable washing machines, etc.

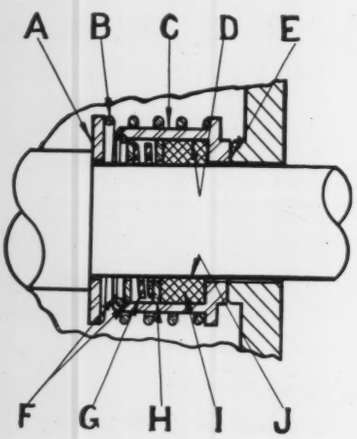


Worm gear reduction is an integral part of the unit which includes a universal motor

Meeting the demand for a small, slow speed universal motor, the EEXQ model, also shown herewith, has a single worm gear reduction as an integral part of the unit. Full load motor speed is 8000 R.P.M. Gear ratios of 15:1, 30:1 and 40:1 are available as standard, giving shaft speeds of approximately 200 to 750 R.P.M.

Seal Rotates with the Shaft

SEALING against the leakage of liquids and gases and adjusting automatically to wear, end play or vibrations are accomplished by the Jensen seal manufactured by Rotary Seal Co., 809 West Madison street, Chicago. The seal, which rotates with the shaft, has a steel ring, *A*, to take spring thrust. A flexible coil spring *B* maintains the face against the seat and allows for end play, wear and vibration. Hardened steel ring *C* is surface enameled at *D* to allow the housing to slide laterally on the packing.

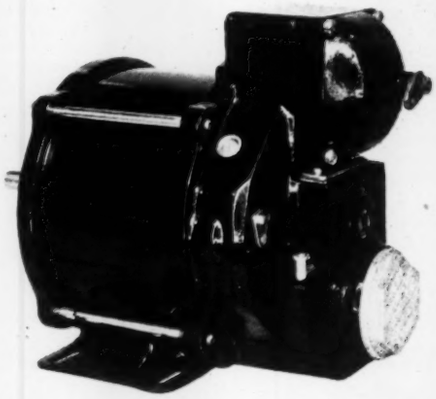


Face of seal is maintained against the shoulder by a spring which allows for end play, wear and vibration

A snap lock ring and washer *F* retains the flat coil spring *G* which maintains pressure on the packing. The packing, *I*, is soft and flexible and is not affected by grease, oil or gases. Efficiency of the seal does not depend on sliding of packing on the shaft.

Switch Protects Enclosed Motors

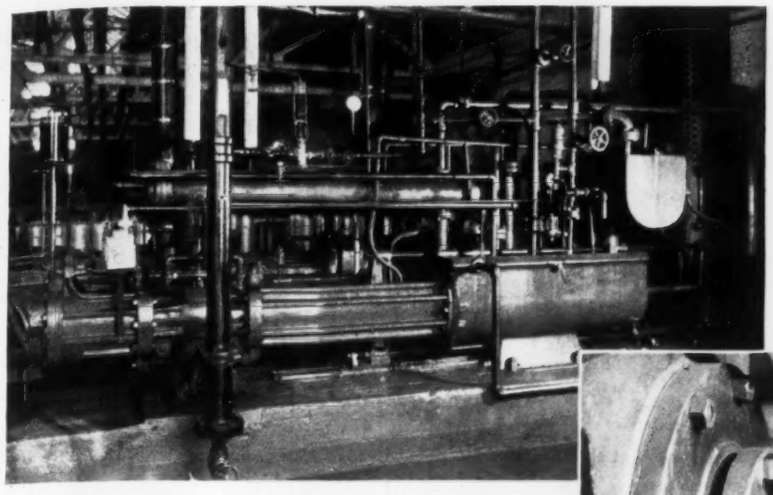
SMALL, explosion-resisting motors for driving pumps at gasoline filling stations and for similar applications have been protected further by an ingenious switch designed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Such motors ordinarily are supplied with four leads which may be connected for either 110 or 220 volt operation. Hitherto, it was necessary to open an enclosed fitting and splice the wires; but now it is only necessary to shift the external index plate which throws a voltage changing switch inside the motor, connecting the windings for the desired voltage. The index plate on the outside gives the voltage connection at a glance.

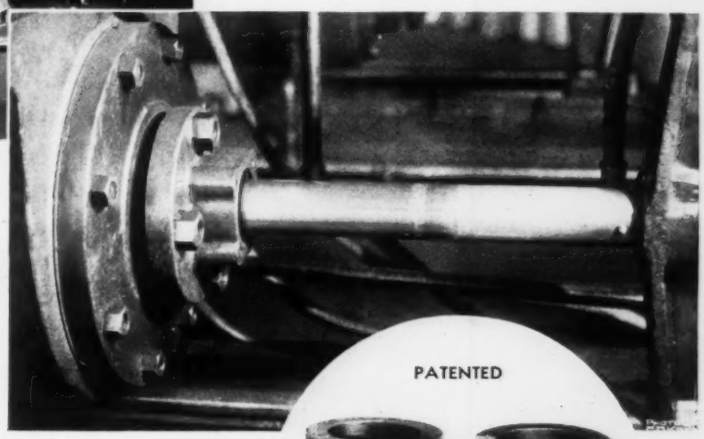


Shifting of external index plate changes voltage on explosion resisting motors

Tubes Are Resistance Welded

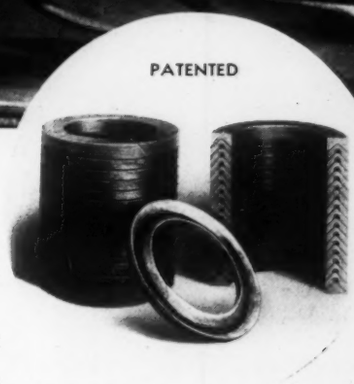
ELECTRIC resistance welded boiler tubes, known as Electrunite boiler tubes, are a recent innovation of Steel & Tubes Inc., Cleveland, a subsidiary of Republic Steel Corp. The tubing is formed from strip steel continuously, the strip being passed through a series of forming rolls. Round butted tube thus formed then passes under revolving wheel-like copper electrodes where current travels from electrode to electrode through the butted section of the tube. At the same time pressure is applied which, together with the heat which is below the fusion temperature and which is confined to an ex-





BACK and FORTH for 3 Years!

This piston rod has traveled 121,305,600 feet... without leakage... packed with CHEVRON



GARLOCK CHEVRON PACKING

WHEN a set of fibrous packing gives over three years continuous service on a compressor—that's something to talk about.

This piston rod has traveled through a set of Garlock Chevron packing a distance of nearly 23,000 miles—almost as far as around the world—and it is still traveling.

The Superintendent of the Pittsburgh plant of one of America's great industrial companies where this Chevron installation was made writes, in part, as follows:

"Garlock 530 Chevron Packing installed on a CO_2 water cooled compressor. The piston rod is a hollow brass rod. Third stage, carrying from 1000 lbs. in winter to 1350 lbs. in the summer. Manufacturing CO_2 gas. "This packing is now in its fourth year of service. It operates on an average of 72 hours a week at 120 strokes a minute—18" stroke. At the end of three years it has gone 121,305,600 feet through the packing and is still in service."

This customer finds this one installation of Chevron has saved him:

$100.00 worth of packing (compared with previous actual costs). Six new piston rods (formerly renewed every 6 months). Labor cost of installing six rods and repacking 6 times.

What Chevron has accomplished for this customer it can accomplish for you. There are not many jobs on which Chevron will not operate successfully and economically. If you are one of the few who have not yet tried Chevron, write or telephone and a Garlock representative will call and tell you the whole story.

The Garlock Packing Company, Palmyra, New York
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal Quebec

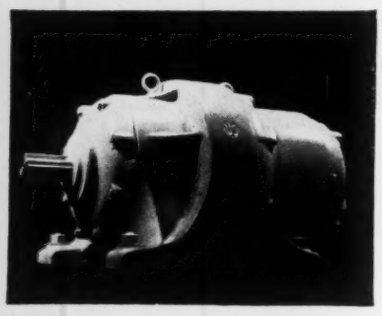
GARLOCK CHEVRON

tremely small area, completes the weld. The tubing later is normalized and fully tested in accordance with American Society of Mechanical Engineers specifications.

Pyramidal Base Supports Unit

BOTH motor and gears are supported in the new Synchrogear motor, designed by U. S. Electrical Mfg. Co., Los Angeles, on the same pyramidal, rigid gear-pedestal, base, centrically located, toward which load and all high torsional stresses converge. This self-contained design of a motor and speed reducer, shown herewith, minimizes cantilever stresses from overhanging gears by a short train structure.

The design is unusual in that the high speed gears are not permitted to be submerged in the reservoir of oil, thus reducing resistance, heat and foaming caused by high speed churning of the lubricant. Forged helical gears and pinions are used which are high in nickel, carbon and molybdenum, heat treated, hardened and ground. Fully enclosed gear compartment excludes foreign matter. Labyrinth seals within



High speed gears are not permitted to be submerged in the reservoir of oil on integral motor and gear unit

shaft apertures prevent oil leakage from the enclosed gear case.

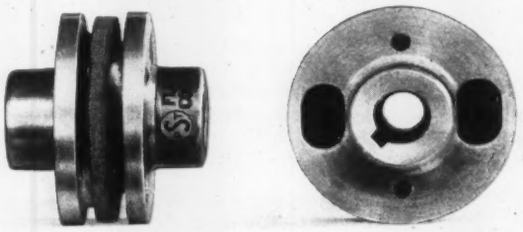
Appearance of the unit gives an impression of streamlining. The motor is insulated with asbestos and is electrically impregnated with asbestosite. Units are available for any speed ranging from 2 up to 10,000 revolutions per minute.

Bronze Bars Are Centered

CORED and solid bars of phosphor bronze bearing metal are being offered by Bunting Brass & Bronze Co., Toledo, O., in a wide variety of stock sizes. Outside diameters of the bars are machined concentric with the inside diameters and the usual centering of the solid bar stock by the user is eliminated as this is performed by the bar maker. The bars are 13 inches long instead of the conventional 12 inches. Hard surface scale is removed in the machining operation at the Bunting plant and there are no under surface casting defects.

Fabric Disks Transmit Torque

A NEW series of small industrial couplings has been introduced by Smith Power Transmission Co., 434 Penton building, Cleveland. Flanges of this series are of special aluminum alloy which has a high strength-weight ratio.



Flanges of new series of small industrial couplings are of special aluminum alloy

Connection of the flanges is made by socket head cap screws through specially designed flexible fabric disks in such manner that there are no metal-to-metal bearing surfaces. The small series couplings, which may be used in either a horizontal or vertical position are available in two sizes: diameter of 2⅝ inches, capable of transmitting 1 horsepower at 1800 revolutions per minute; and diameter of 3⅛ inches capable of transmitting 3 horsepower at 1800 revolutions per minute.

Motorized Reducer Is Sealed

A WIDE range of reductions has been made available with the line of new motorized speed reducing transmissions introduced by Morrison Machine Co., 1171 Madison avenue, Paterson, N. J. The construction is completely sealed to prevent oil discharge or infiltration of dirt. Adjustability of the position of the output shaft is provided by a clamp screw which, when loosened, allows free rotation of the gear mechanism permitting the spindle to be turned around the axis of the reducer to any distance from the base described by the circle of rotation.

The unit shown herewith has a ratio of 80.6 to 1. This particular motor contains a mechanical braking device enclosed in the sheet metal drum on the posterior portion of the motor. Horsepower ratings from small fractional

SAVE...WITH THE HELP OF NICKEL

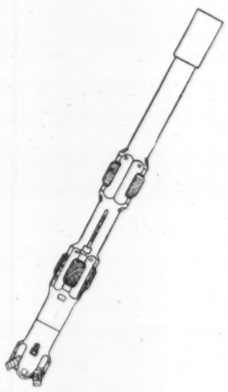
GAIN THE ECONOMY OF IMPROVED PERFORMANCE AND LONGER LIFE FOR YOUR MACHINERY AND EQUIPMENT

IN THE WAR against the ravages of wear, corrosion, heat, fatigue and shock, nickel can be used as a valuable ally.

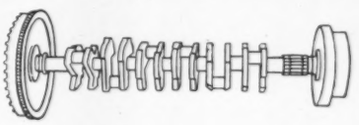
Nickel alloys are uniform in properties and dependable in performance. They permit economy in design, as due to their greater strength, toughness and wear-resistance, smaller sections often can be used.

Other savings are attainable through the ease with which nickel alloys respond to ordinary manufacturing operations. Often these savings outweigh the slight initial difference in material cost.

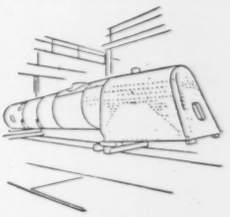
With nickel alloys, the particular properties desired can be duplicated regularly in commercial production. This assures more reliable performance of the finished product, and reduces rejections in the manufacturing process.



Nickel alloy steels are commercially the most important of the useful nickel alloys. They have been cast, forged and rolled on a production basis for more than forty years. Service records established during this period by nickel alloy steel parts are eloquent testimony to their inherent reliability.

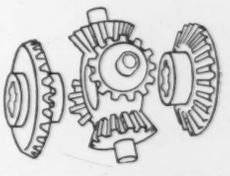


Commercial nickel alloy steels are regularly produced by all alloy steel mills and leading foundries. Rolled forms are carried in stock by warehouses in important industrial centers. These producers and vendors will welcome the opportunity to assist in the selection of compositions and treatments best suited to meet your particular requirements.



If the improved properties and dependable performance of nickel alloy steels are of interest to you, we shall be glad to put you in touch with established sources of supply.

Our engineers will also be glad to assist you to select suitable compositions and appropriate heat treatments for your particular applications.



Send for Bulletin Number 3 "Heat Treatment and Applications of Nickel and Nickel Chromium Steels."

Typical Uses

Some important applications of nickel alloy steels in various industries are: automobile, aircraft and motorcycle construction, locomotive and railroad car parts, mining, excavating, milling, lumber mill and power machinery, machine tools, steam and hydraulic turbines, electrical machinery, marine shafting, die blocks, ordnance, oil field tools.

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PERFORM BETTER LONGER

THE INTERNATIONAL NICKEL COMPANY, INC.

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TRI-MARKT

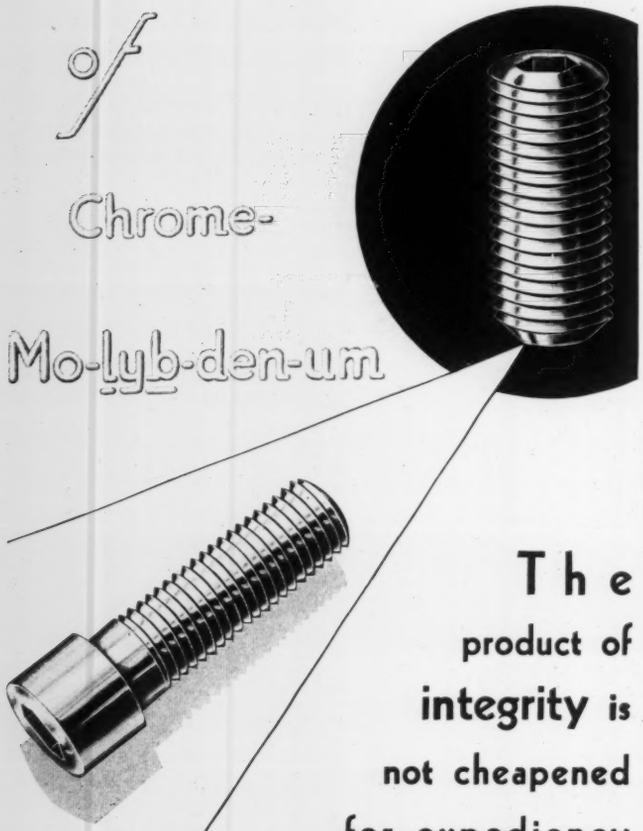
TRADE MARK

HOLLOW SCREWS

of

Chrome-

Mo-lyb-den-um



The product of integrity is not cheapened for expediency OR EMERGENCY

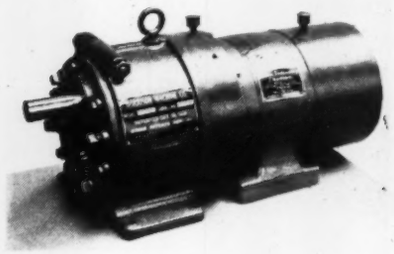
There is today no more advantage in buying a cheapened product than there ever was. Now as formerly there is nothing saved by paying less and getting still less. Sound buying policies have been relaxed, not by process of reasoning but by pressure of emergency. *Emergency works no miracles* in putting value or serviceability where it wasn't. . . Running normally, you would use only *ALLENS*. Reasoning normally, you will use *ALLENS* now—and they will be the *best* Allens you ever used! Free *samples* in any sizes specified.

THE ALLEN MFG. COMPANY

HARTFORD, CONN. U. S. A.

sizes up to 2000 horsepower are available.

The company is also producing a right angle delivery reducer. In this model, the output shaft may be adjusted to give an upward or downward vertical position, a horizontal position in either direction or a position of 45 degrees to the horizontal in any direction either above or below the horizontal.



Output shaft on integral units may be adjusted to many different positions

Capacitor Is Mounted on Base

FOR the more exacting demands of household duty on small motors, Baldor Electric Co., St. Louis, has perfected its earlier development of the capacitor motor in the Type A motor shown herewith. The electrolytic capacitor is placed in the base over which the motor is mounted on springs. Stator frame is of the rolled steel type and is dynamically balanced.

Electrolytic capacitor is placed in the base over which the motor is mounted on springs

The punchings and windings embody the sine distributed magnetic circuit developed by the company for single phase induction motors. Solid stock phosphor bronze bearing metal is machined and ground to size for the bearings.

Offers New Nickel-Chrome Alloy

A NEW SERIES of Nichrome alloys to be known as Nichrome V is the latest step in the development of nickel-chromium alloys developed by Driver-Harris Co., Harrison, N. J. This series is designed to meet the demand creat-

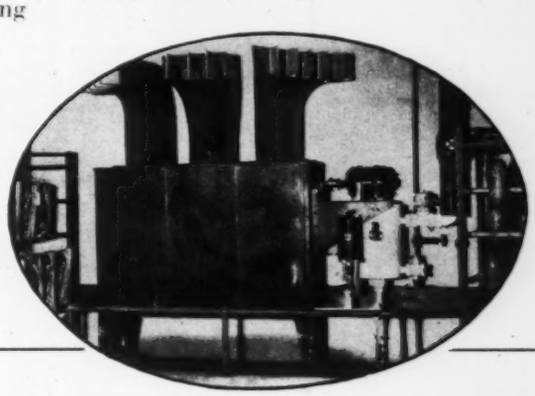
BLOWERS
FANS
UTILIZE W·I·R BALL BEARINGS

"Particularly suitable to whole industry," *explains April "Dragon"*

Manufacturers of blowers, fans and air conditioning equipment are extremely large users of Fafnir W.I.R. (Wide Inner Ring) Ball Bearings. The Clarage Fan Company, for example, uses Fafnirs as standard throughout its entire line of Unit Heaters, Coolers and Air-Conditioners, as well as on practically all its blowers and fans. This quarter-century old company finds that the requirements of reliability, high speed, thrust capacity, control of shaft balance, low maintenance cost and lubrication savings can be most satisfactorily met by Fafnir Wide Inner Ring Bearings. And their experience is pretty generally endorsed by the industry as a whole.

The new "Dragon" carries descriptions of Clarage Fan Company's applications which may be quite suggestive to machinery designers. Have you read your copy?

Fafnir Wide Inner Ring Ball Bearings enjoy a justly deserved popularity in many quarters because they are as easy to apply from the designing point of view as from the manufacturing standpoint. Standard Fafnir applications fit a surprising number of jobs and for the "specials" there is at the customer's disposal the entire facilities of our trained engineering department here at New Britain.



THE FAFNIR BEARING COMPANY
New Britain, Conn.

Atlanta Chicago Cleveland Dallas Detroit
Los Angeles Milwaukee New York Philadelphia

Fafnir·Ball·Bearings

"Spot" says:

"Let me spot your heat exactly where you want it"

TWO spots of heat were needed to seal the packages in this ice-wrapping machine, which operates in a room at freezing temperature. Two "Spots"—G-E cartridge-type electric heating units—solved the problem simply and easily. They thoroughly heated and dried the glue used to hold the wrapper in place, even though the heaters were pressed against the wrapper, which was directly in contact with the ice.

You may not operate an ice-wrapping machine, but you may have a process machine, or a dozen "fussy" heating problems that "Spot" can easily solve. Spot heaters cost so little that you can use them everywhere. They are priced as low as $2.00. Order them from your G-E mail-order catalog, which describes and prices the complete line of G-E Midget heating units and devices.

If you haven't a copy of our mail-order catalog, fill in this coupon and mail it to the nearest office of your power company, or write General Electric, Schenectady, N. Y.

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GENERAL ELECTRIC

Please mail me a free copy of the General Electric mail-order catalog, GEA-1520, on small electric heating units.

Name.....

Firm.....

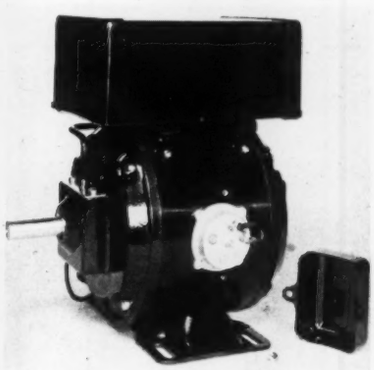
Street.....

City.....State..... (MD)

ed by increased machine speed, higher temperatures and longer life. The performance of the alloy on the test board of the company indicates that it has the necessary qualities to a greater extent than materials heretofore offered.

Protect Motors Against Burnouts

EQUIPPED with a small disk-type thermostat, the line of single phase capacitor motors designed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., protect themselves from burning out regardless of service conditions. Mounted on the motor frame, the thermostat opens the supply circuit when the motor temperature approaches a dangerous value and automatically restarts the motor as soon as it cools down.



Capacitor motors protect themselves from burning out regardless of service conditions

The thermostat has but a single moving part, a small bimetal disk which buckles at definite temperatures. Arcing is practically eliminated by the speed at which contacts are made. The motors are attached to the pressed steel base by springs which are attached to lugs on the base and extend to the bottom of the oil reservoir where the springs are securely bolted.

Motor Frames Are Ventilated

OPERATING at 1725 revolutions per minute, the new line of 3-horsepower motors offered by Emerson Electric Mfg. Co., St. Louis, is furnished in single phase repulsion start induction, polyphase squirrel cage and direct current compound wound types. Shafts in the new motors are of tool steel while bearings are of bronze and are wool packed. Motor frames have ventilating openings and a fan on the armature shaft provides a constant circulation of air through the motor. Ventilating openings are so arranged that protection is afforded from damage by dirt or water falling from above.

The *little* precautions which make a *great* motor!

Checking vibration of finished F-M Motor. Special vibrometer records vibrations to .0001-inch sensitivity

YOU can make motors by the thousand on the production line—but if you want the refinements and precision which are necessary to make a truly *great* motor, you must use laboratory methods.

In the F-M plant, these laboratory methods are not merely a control check to secure average results. *They are a complete and thorough series of measurements and operations on each motor that goes out bearing the F-M nameplate.*

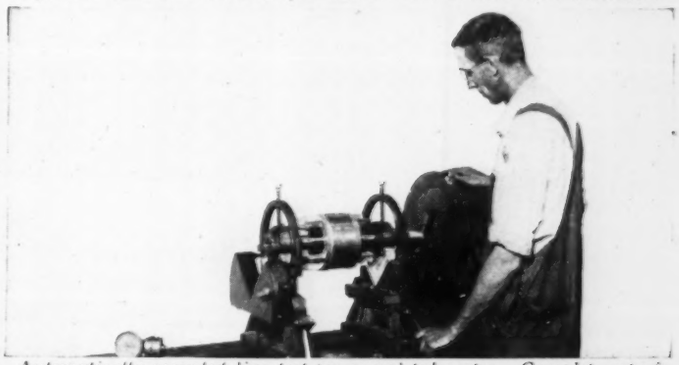
Rotors for example: Made strictly to rigid specifications, each rotor is individually tested and compensated to close limits of dynamic balance, and after assembly the completed motor again tested to make certain that vibration will not shorten the long service life for which these motors are noted.

Dynamic balancing machine for rotors. Has special neon indicators

It is in these small and detailed laboratory methods of testing and elimination of defects that F-M motors achieve their greater ability to serve.

It is the reason why the machinery manufacturer can rely on these motors to add to the dependability of the machine of which the motor is a part. It is the reason why the F-M Motor is a sales feature and sales aid.

Complete information and descriptive literature sent on request by writing Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago. 32 branches at your service throughout the United States.



Automatically recorded line test for completed motor. Complete set of charts from meters accompanies motor to receive final approval or rejection

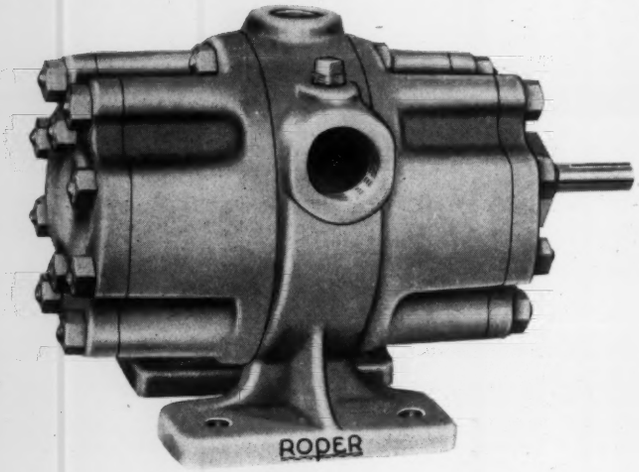
FAIRBANKS-MORSE

MOTORS

POWER PUMPING AND WEIGHING EQUIPMENT

5865-EA40.51

A new specially designed sleeve bearing Pressure Pump



for non-lubricating liquids

A herringbone gear, sleeve bearing, pressure pump. Especially adapted to uses in the Rubber, Soap, and Chemical Industries; also on large hydraulically actuated elevators; and other installations where the use of petroleum products as the hydraulic medium is undesirable. Maximum operating pressure, 300 pounds.

ROPER

Roper manufactures a COMPLETE line of hydraulic pressure pumps for pumping lubricating or non-lubricating liquids. Efficient and economical operation is assured. Pumps built in a wide variety of sizes, capacities, and with great mounting flexibility. Readily adapted to any hydraulic installation requiring not over 1000 lbs. pressure.

Fill out and mail the coupon below for additional information.

Name.....

Company.....

Address.....

I am interested in pumps for:.....

GEO. D. ROPER CORP.
480 Blackhawk Ave., Rockford, Ill.

Attractive Metallic Coatings Combat Corrosion

(*Concluded from Page* 21)

cause corrosion when the part is exposed. Furthermore, plating liquids are trapped and cannot be removed in the rinsing operations.

There are two ways of minimizing this difficulty. In Fig. 5*B* the opening is larger and there will be reasonably thick deposit on the inside. Also the rinsing will take place easily. The second method is to close the opening completely as shown in *C*. However, this latter type of bead is difficult to accomplish, and there generally will be some point which is not closed completely. This method should not be employed unless the bead can be sealed by means of a special operation such as soldering or welding.

As parts which are plated in still tanks and automatic plating machines are suspended in the various solutions on individual hooks or on racks, it is necessary that a suitable place be provided for the hook. The main consideration besides those already discussed is that the center of gravity should fall considerably below the point of suspension so that the article will slide into the baths without unhooking.

Suitable design is particularly important when full-automatic plating machines are used. While such mass production machines have cut plating costs tremendously, they are not as flexible as hand-operated equipment. The rate of upward and downward movement in transfer from tank to tank cannot be varied in most automatics and, as the parts cannot be reracked conveniently during the cycle of operations, design for racking must be as nearly fool-proof as possible.

From the foregoing it is shown that it pays the designer to devote consideration to the fundamental principles which govern electroplating. The following vital points should be watched: Choice of deposit; specifications; depth of recesses; shape of inside corners; shielding of one area by another; gas pockets; proper draining; racking; and stability of suspension.

Articles on this and allied subjects presented in previous issues of MACHINE DESIGN are:

"Overcoming Sales Resistance by Color Effects and Finishes," by William J. Miskella, March, 1930, p. 15.

"New Use of Chromium Plating," April, 1930, p. 21.

"Evolution in Finishing Processes Worthy of Designer's Study," by M. J. Callahan, May, 1930, p. 46.

"Effecting Economies in Finishes," by William J. Miskella, Nov., 1930, p. 41.

"Specify Proper Finish and Color for Your Product," by T. J. Maloney, Jan., 1931, p. 33.

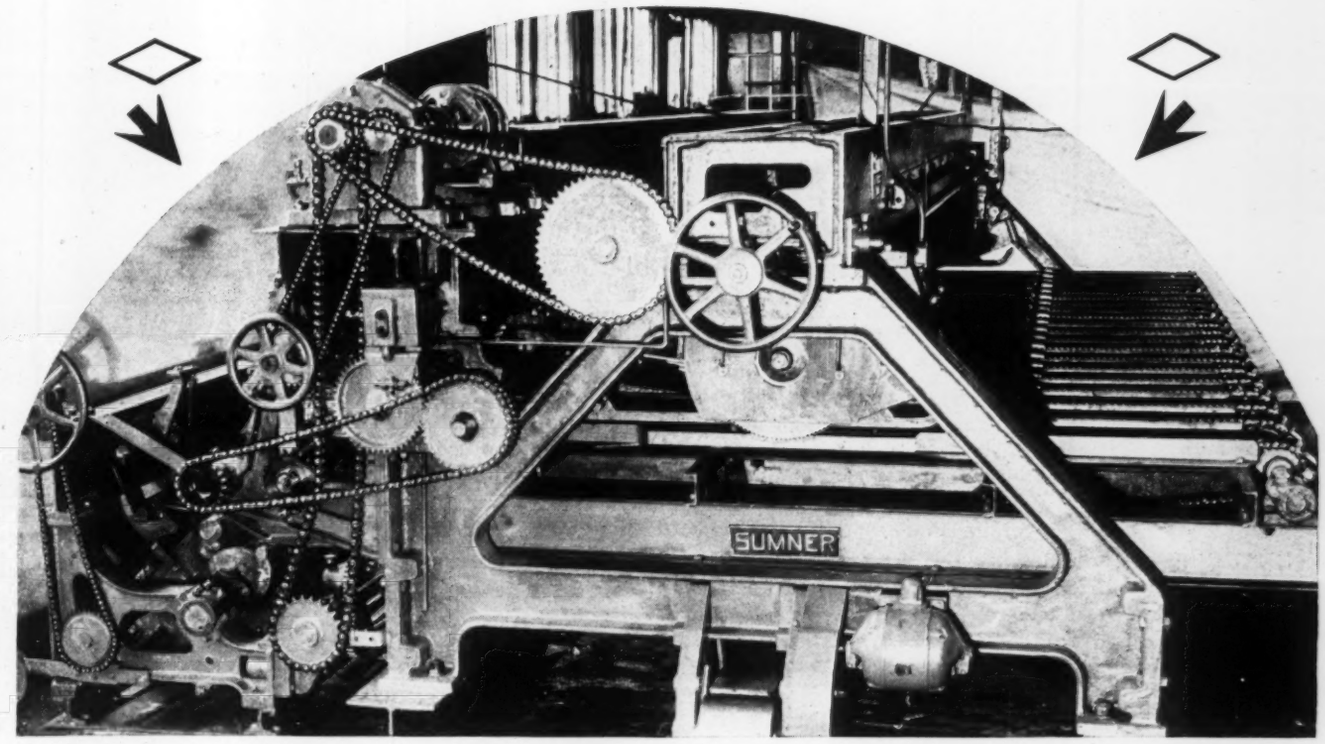
"Considering Machine Finishes from the Sales Standpoint," by William J. Miskella, May, 1931, p. 41.

"Improving Design with New Finishes," by William J. Miskella, Oct., 1932, p. 37.

"Porcelain Affords Protective Coating," Nov., 1932, p. 23.

"Sprayed Metal Offers Possibilities," Dec., 1932, p. 21.

"Supplementing Mechanical Efficiency with Good Appearance," by Walter Dorwin Teague, Dec., 1932, p. 22.



COULD *YOU* DO THIS JOB IN A SIMPLER, BETTER WAY?

Lumber is squared at each end—stamped with Four Square Trade-Mark—pricked at inch intervals

All these operations, of course, are done at high rate of speed—all the motions are exactly timed and co-ordinated one with the other.

The manufacturer's designing engineers accomplished these results with Diamond Roller Chain—chain made by an organization that has specialized in this one kind of power drive for over 40 years.

The benefit of experience gained in the working out of roller chain applications is yours for the asking.

DIAMOND CHAIN & MFG. COMPANY
435 Kentucky Avenue **Indianapolis, Ind.**
Offices and Agents in Principal Cities

By use of Diamond Roller Chain, simplification of design is accomplished—shafts located where convenient and accessible, and positive co-ordination of motions assured. Booklet 104-A shows other examples of Diamond Chain uses of interest to machinery manufacturers and designers. Snip the coupon reminder and mail.

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for Every Industrial Need

This Diamond on every link identifies the Diamond Drive

Quiet—Clean—More Compact per H. P. Transmitted

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435 Kentucky Avenue, Indianapolis, Indiana
Gentlemen: Please send me a copy of Booklet 104-A, "Simplifying and Improving Machine Design."
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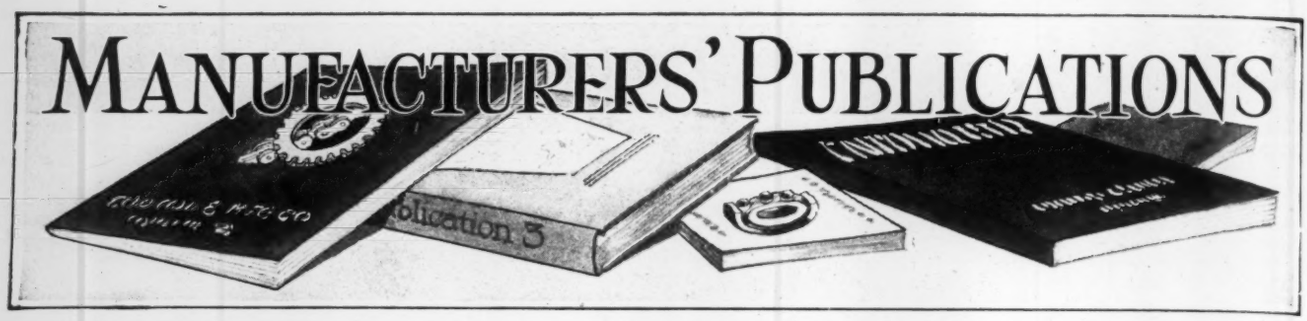


Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (NICKEL)—The use of alloy cast iron for camshafts, a radical departure from previous practice, is described in a comprehensive article in the February *Nickel Cast Iron News* published by International Nickel Co., New York.

BEARINGS—Fafnir Bearing Co., New Britain, Conn., is issuing a bulletin on its line of felt seal ball bearings. The booklet includes a description of the single and double seal types, advantages, applications, cross-sectional drawings and engineering information.

CAST PARTS—Chicago Die Casting Mfg. Co., Chicago, has published special stock bulletin No. 28 listing its line of die cast pulleys, couplings, bearings, etc.

CAST PARTS—"Properties and Advantages of High Chromium Cast Iron," is the title of a bulletin issued by Electro Metallurgical Co., New York. Information is given on composition, methods of melting, fluidity, physical properties, growth, scaling, corrosion and cost.

COUPLINGS—Standard sizes of couplings and casings for use under adverse conditions are included in a folder issued by Link-Belt Co., Indianapolis, on its recently introduced line of flexible couplings which consist of two cut-tooth sprocket wheels and a piece of roller chain to connect them.

DRIVES—B. F. Goodrich Co., Akron, O., has issued three new catalog supplements on its belting. The publications cover Highflex transmission belting, axle lighting belting and Maxecon general service conveyor belting.

DRIVES—Any speed ranging from 2 to 10,000 R. P. M. is available with Syncrogear motors, presented in a recent bulletin of U. S. Electrical Mfg. Co., Los Angeles. Both motor and gear are supported by a pyramidal, rigid pedestal base centrically located.

DRIVES—Falk Corp., Milwaukee, is distributing bulletin 261 which describes its new line of geared-head motoreducers. The bulletin on these units, especially designed for relatively low ratios, includes a cross-sectional view of the geared head and engineering information.

FASTENINGS—Elastic Stop division, A. G. A. Co., Elizabeth, N. J., has published a bulletin which presents technical data on the use of elastic stop nuts. The bulletin gives typical applications in many fields, explains the principle of the fastening design and includes specifications and dimensions.

MOTORS—Dumore Co., Racine, Wis., has issued bulletins describing three motors recently developed. These motors are a series universal type, a unit of similar construction enclosed for use with portable drills, etc., and a universal motor with single worm gear reduction as part of the unit.

PACKING GLANDS AND PACKING—An oil seal which rotates with the shaft, known as the Jensen seal, is described in a folder of Rotary Seal Co., Chicago.

TUBES—Steel & Tubes Inc., Cleveland, has prepared a folder on its Electrunite electric resistance welded boiler tubes, the first departure from boiler tube practice in many years.

WELDED PARTS AND EQUIPMENT—A 42-page booklet on the welding of aluminum has been prepared by Aluminum Co. of America, Pittsburgh. The booklet describes the various operations in welding and illustrates welding rods.

Research Publications

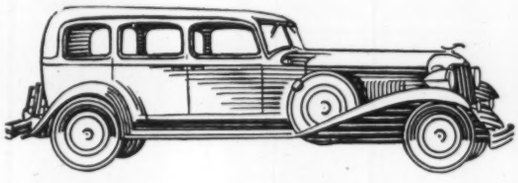
Tentative Specifications for Malleable Iron Castings. Such castings as used for railroad, motor vehicle, agricultural implement and general machinery purposes are covered by these specifications designated A 47-32 T. Manufacture, physical properties and tests, workmanship and finish, marking and inspection are considered. Criticisms are solicited by the society. Published by American Society for Testing Materials, Philadelphia. 4 pp. Free.

Welding with Manufactured, Natural and Mixed Gas. by H. H. Lurie. Exhaustive investigation of welds and the method of making them with these gases. Tests and X-ray examination of the welds is reported, and a description of four torches developed in the laboratory is given. Published as research bulletin No. 41 by Engineering Experiment Station, Purdue university, West Lafayette, Ind. 114 pp. 50 cents.

Gear Train Design, by William H. Rasche. A new method of using Brocot's table of decimal equivalents in calculating the numbers of teeth in a gear train is presented in this publication. The comprehensive discussion covers the theory of the Brocot table of decimal equivalents, properties of the table, mathematical principles of the table, analysis of the function $(ax + c) / (bx + d)$, problems in gear train design and their solutions, and the complete Brocot table of decimal equivalents. Published as engineering experiment station series bulletin No. 14 by Virginia Polytechnic institute, Blacksburg, Va. 111 pp.

YOUR PRODUCT must be lighter?

Call upon Electromet Service



■ If your product must be made lighter without a sacrifice of strength, one solution is to replace ordinary steel with alloy steel parts. Before you write your specifications, however, supplement your knowledge of alloy steels with the vast fund of practical information that Electromet Service offers you without charge. As the pioneer producer of ferro-alloys and metals for steel-makers, Electromet has accumulated a body of data which, applied to your problems, will insure utmost economy in design and maximum satisfaction in performance. To realize maximum return on your investment in alloy steels, utilize Electromet Service. A request on your letterhead will bring you complete information.

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